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UNITED STATES ARMY SPECIAL WARFARE SCHOOL

INTRODUCTION TO DEMOLITIONS

COMMENT
H to H+ 10

Many of you perhaps wonder why MATA bothers to teach demolitions, since you have been told that the Viet Cong do not have large permanent-type installations, vehicle support, bridges, etc. Demolitions, nevertheless, has a very important place in counterguerrilla operation. This class is designed not only to show you HOW but Why.

The use of demolitions has not been fully exploited by the Republic of Viet-Nam chiefly due to: (1) lack of knowledge; (2) and due to fear generated by the lack of knowledge.

I would like to point out to you some methods by which demolitions may be of tremendous help.

First, consider demolitions from the military point of view. Demolitions can be of great assistance in the defense of outposts and new life hamlets. Ambushes of varying kinds and sizes may be easily employed with no exposure of friendly personnel. Key political and military leaders of the Viet Cong may be eliminated quite easily with some of the devices you will see demonstrated. Timber and stumps can be removed with more speed to clear for helipads, LZ's, and DZ's. Those all-important moats surrounding villages, outposts, and military installations can be constructed with less manual labor with demolitions.

Second, it is often said that this is a war for the minds of men. And most certainly, "civic action" work is the most assured way of winning the mind of a man. Demolition is of great help to clear land for farms and to build roads in order that the farmer may get to market. Demolitions have been used to clear land for new life hamlets. Construction of canals and drainage ditches lends itself quite well to the use of explosives.

COMMENT

CHARACTERISTICS AND PROPERTIES OF MILITARY EXPLOSIVES

H+ 10 to H+ 15

There are certain characteristics that all explosives must meet before they are accepted by the U.S. Army. Of all these characteristics, only one is of importance to the individual soldier, and it is "military explosives are relatively insensitive to shock, heat, or fraction." This means they are not liable to detonation by small arms fire.

COMMENT

DETONATING VELOCITY

H+ 15 to H-20

At this time I will discuss detonating velocity. Detonating velocity is the speed at which the shock wave passes through a column or block of explosive. It is always expressed in feet per

second. This is the "yardstick" by which we choose from several explosives for a specific job. An explosive with a low detonating rate, such as ammonium nitrate, pushes and shoves. Therefore, it is more suitable for clearing land, cratering and ditching, quarrying rock, etc. An explosive with a high detonating rate, such as C-4, tears and shatters. This makes it more suitable for breaching concrete, cutting steel or timber, and sometimes as a propellent in the case of the claymore mine. In order to select one type of explosive from several different types, first decide if the explosive must tear and shatter or push and shove, and the choose, by detonating velocity, the explosive that best fits the job. Detonating velocities are listed in FM 5-25 and FM 5-34.

NOTE

Demonstrate the push of explosives and the shattering effect with a glass jar and hammer.

COMMENT

NON-ELECTRIC FIRING SYSTEM

H+ 20 to H+ 50

At this time I will begin the real "meat" of the subject and that is the non-electric firing system. Before any explosive can be detonated, it must first be equipped with some sort of device to produce detonation. The act of equipping the explosive with this device is called "priming" and the finished product is the "primer." Now, let's look at the non-electric primer. A non-electric primer consists of (1) a length of time fuze, (2) a non-electric blasting cap, (3) a piece of explosive, and (4) any item necessary to join these components together as one unit. As you noticed, the means to ignite the time fuze is not a part of the primer. The attachment of a means of ignition of the time fuze constitutes the non-electric firing system.

NOTE

POST A1 AT THIS TIME AND COVER THE FOLLOWING:

COMMENT

FUZE LIGHTERS

The first component to be covered is the fuze lighters. The U.S. Army issues two types of fuze lighters, the M-2 and the M-60, and both may be found in Viet-Nam.

1. M-2 Fuze Lighter: This is the M-2 fuze lighter. It is of all-metal construction. To use, you must first remove and discard the rubber shipping plug and insert the time fuze. On insertion of the time fuze, some resistance will be met, but firm pressure will overcome the initial resistance and the time fuze will move about another quarter-inch. The fuze is now fully seated. The weatherproofing compound is compressed around the time fuze to weatherproof, not waterproof, the device. An expedient means of waterproofing will be discussed in subsequent instruction.

NOTE PLACE CHART No. 1, M-2 FUZE LIGHTER, ON THE GTA STAND AND DEMONSTRATE THE FOLLOWING:

COMMENT The initial resistance met is due to a set of metal grippers that prevent the time fuze and fuse lighter from separating. When ready to ignite the time fuze, pull vigorously on the release pin. This releases a spring-driven striker which detonates a "shot-gun type" primer. The spurt of flame produced by this primer ignites the time fuze. As a point of interest on the M-2 fuze lighter, the base may be unscrewed from the body and the metal grippers removed with a nail which will allow the base to accommodate a .22 caliber round. The base is reinstalled in the body, thus producing an excellent "zip-gun." This surprise weapon is a one-shot affair, and you must be close to the target to affect a hit.

NOTE PLACE CHART No 1A ON STAND AND EXPLAIN THE FOLLOWING:

2. M-60 Fuze Ligher: The remaining fuze lighter is the M-60 model. It is of metal and plastic construction and contains a safety wire. To use the device, loosen but do not remove the base collar. Push in on the plastic shipping plug, remove, and discard. Insert the time fuze till fully seated and tighten the base collar. When ready to ignite the time fuze, remove the safety wire, take up slack on the release pin, and pull vigorously on the release ring to fire. The function of the M-60 is very similar to the M-2. If the device fails to fire, push the release pin in as far as possible and refire.

NOTE USE INERT TRAINING AID TO DEMONSTRATE THE FOLLOWING:

COMMENT An expedient method to waterproof the fuze lighter is to place it inside of a balloon and secure the balloon firmly around the time fuze with string. The balloon will easily stretch allowing the lighter to fire. When using this method with the M-60 lighter, remove the safety wire prior to placing it in the balloon.

3. Match Method: In the absence of the issued fuze lighters, time fuze may easily be ignited with a common match. To accomplish this, split the end of the time fuze about one-half inch and insert the match allowing the head to protrude slightly. To strike the match, draw the abrasive across the head of the match. Another method is to light a second match and light the match head in the time fuze.

TIME FUZE

Time fuze is a train of black powder surrounded by several layers of waterproofing material. It may be any color; however, the U.S. Army issues dull orange or green in color with green being predominant. It is completely waterproof except on the open ends and once ignited, will burn underwater.

NOTE DEMONSTRATE BURNING OF TIME FUZE UNDERWATER

COMMENT Burning rate of U.S. Army time fuze is 30 to 45 seconds per foot. To properly use the time fuze, cut off and discard the first 6 inches. This is a precaution in the event moisture has seeped into and damaged the train of black powder. Next, measure and cut off a 1-foot length of the fuze. (Due to the fact that anyone seldom has a ruler with them, the crimpers are used in the fully opened position as a standard unit of measure. Crimpers in this position equal approximately 1 foot. The measuring device doesn't matter as long as you use the same device to time and measure the time fuze.) This length of time fuze is ignited and the burning rate established for that roll of time fuze.

NOTE DEMONSTRATE THE ABOVE

COMMENT By knowing the burning rate for one crimper length, it is a simple problem to figure the number of crimper lengths required for a specific length of time.

This operation must be repeated (1) when a new roll of time fuze is opened, (2) when the time fuze has remained unused for a period of 12 hours or longer, and (3) any time there is an extreme change in weather since the burning rate was last established.

NOTE PLACE CHART No. 2, NON-ELECTRIC BLASTING CAP, ON GTA STAND

COMMENT At this time I will demonstrate the "heart" of any charge and that is the blasting cap. Nomenclature is, cap, blasting, special non-electric (type 1) (J1 PETN). The non-electric special blasting cap consists of a copper or aluminum shell with a cavity provided to receive the time fuze. This cavity precedes a flash charge. The flame transmitted by the burning time fuze strikes this flash charge, causing it to ignite. Heat produced by the burning flash charge causes detonation of the priming charge which is very sensitive to shock, heat, and flame. The detonation of the priming charge is of sufficient strength to cause detonation of the base charge. This is a chain reaction that for all practical purposes is instantaneous. At this time, I want to impress you with two different points. First, this is an ordance corps special blasting cap and is far more powerful than the commercial caps that are used with the highly sensitive commercial explosives. The special blasting cap is required to obtain positive detonation with ALL U.S. Army military explosives. The more powerful special cap is required because of military explosives being relatively insensitive to shock. In subsequent instruction a field expedient method of using commercial caps to detonate military explosives will be covered. The second item of importance is the sensitivity

of blasting caps. All blasting caps must be protected from flame, shock, friction, and unnecessary rough handling. Wooden cap boxes are provided for safe handling and transporting of non-electric caps once they are removed from the shipping can. The cap box we have here will hold a total of 10 blasting caps. Cap boxes are available for 10 caps and 50 camps.

NOTE

PLACE CHART No. 3, M-2 CAP CRIMPERS ON GTA STAND

COMMENT

The next step that I will cover is crimping of a non-electric blasting cap to a length of time fuze. The purpose of crimping a non-electric blasting cap to a piece of time fuze is to provide contact between the black powder of the time fuze and the flash charge of the cap. This operation can be performed without crimping a blasting cap; however, it is the easiest method. This operation is one of the most important steps in preparing a non-electric primer. A tool designed for this operation is the M-2 cap crimpers. This device is manufactured from a non-sparking material but they do conduct electricity. One handle is a screwdriver blade and is used to remove the screws of the boxes of explosives and another which will be explained during the period of instruction on electric firing systems. The other handle is a punch for making priming wells in explosives only. Near the pivot we see two pairs of jaws. The jaw nearest the pivot overlaps when the handles are compressed. These jaws are used for cutting time fuze and detonating cord. The cutter jaws do not close completely when the handles are compressed. This is due to a stop and configuration of the jaws. A hole about ¼-inch in diameter will be visible in the upper jaw when the jaws are closed. These jaws are used for crimping the blasting caps. Under no circumstances are the cutting jaws used to crimp caps as this action would cut the cap and possibly result in detonation and injury. The non-electric blasting cap is crimped in the following manner. First, insure that a square cut exists across the diameter of the time fuze. Grasp the time fuze leaving the index finger free. Place the blasting cap on the time fuze. The index finger is used to insure the blasting cap remains fully seated. Hold the blasting cap at eye level. The first jaws of the crimpers are placed around the fuze cavity end of the blasting cap. The crimpers are never more than ¼-inch from the end of the blasting cap. The wrists are rotated to the front still maintaining the crimpers at eye level and the handles of the crimpers are squeezed firmly, then the crimpers are removed. Reason for rotating the wrists is to place the crimpers between the face and cap in the event of an accident causing the blasting cap to detonate. The crimping is necessary (1) to prevent the separation of time fuze and cap, (2) for waterproofing the blasting cap. Additional waterproofing capability is obtained when a second crimp is made ⅛-inch above the original.

COMMENT

At this time I will demonstrate priming of various military explosives. As each type of explosive is primed, I will give you some pertinent information on that particular explosive.

1. Priming of TNT: TNT is packaged in 1-pound, ½-pound and ½-pound blocks wrapped in heavy cardboard containers. One of the metal ends is provided with a threaded cap well. By removing the cardboard container of the 1-pound block, two ½-pound blocks will be disclosed. Because TNT is a hard, cast explosive each block contains a cap well. Detonating velocity is 21,000 feet per second. It is an excellent explosive that may be used for all types of demolition work. This detonating velocity of 21,000 feet per second would provide a 1-second period of time to detonate a series of TNT blocks laid end to end for a distance of 4 miles. For the "nit-pickers," I'm 120 feet short.

NOTE

Explain plastic priming adapter prior to priming TNT.

COMMENT

a. To prime the block with the plastic priming adapter, pass the capped time fuze through the adapter making sure the threads of the adapter are nearest the blasting cap. Break the seal on the priming well with the punch end of the crimpers and insert the blasting cap. Thread and tighten the priming adapter.

b. To prime the block of TNT without the priming adapter, break the paper seal and insert the cap. Secure the cap and time fuze to the explosive with tape or string. If string is used, do not tie the knot too tight; otherwise the black powder train may be damaged.

2. Priming of Comp. C-4: Comp. C-4 is issued in 2½-pound blocks contained in a clear plastic covering. Detonating velocity is 26,000 feet per second. It is a pliable explosive which may be cut or molded to fit an irregularly shaped target or object. Molding should be held to a minimum as thic changes the density of the explosive and decreases the detonating velocity which has direct influence on the effectiveness of the explosive.

a. To prime this explosive in the block form, fashion a priming well in either end of the block with the punch leg of the crimpers and insert the fuzed cap and secure with tape or string. Compress explosives firmly around the cap.

b. When priming comp. C-4 in a molded form, first mold and secure the explosive to target, then fashion a priming well at any convenient location and insert the blasting cap. Attempt to maintain at least 1-inch of explosive at each end of the blasting cap and ½-inch on all sides.

3. Priming of Dynamite: Military dynamite is issued in sticks 1½ by 8 inches long. Detonating velocity of military dynamite is 20,000 feet per second. The detonating velocity of commercial dynamite varies between 8,000 and 19,000 feet per second depending on the variety. FM 5-25 lists the detonating velocities. Military dynamite differes from commercial dynamite since it does not contain nitroglycerin, therefore safe storage and handling in combat areas is provided. The greatest use of dynamite is for land clearing and quarry work.

a. One method of priming dynamite is to provide a priming well in the end of the cartridge. Make the priming well in the end which has the "star-crimp" shape. If the well is made in the opposite end, several layers of paper must be penetrated. After producing the priming well, insert the blasting cap and secure with tape, string, small wire, etc.

b. Another method is to open the crimped end of the cartridge and remove a small amount of the dynamite, then produce the priming well and insert the blasting cap. Next, close the cartridge around the time fuze and tie securely. This has the advantage of extra waterproofing.

c. Side priming method: Punch a hole in the cartridge about 1½ - inches from one end. Point the hole so that the blasting cap when inserted will be nearly parallel with the side of the cartridge and the explosive end of the cap will be at a point about half the length of the cartridge. Insert a fuzed blasting cap into the hole and wrap a string or piece of tape tightly around the fuze and then around the cartridge, making two or three light turns before typing the string.

4. Priming of Tetrytol: Tetrytol is packaged in 2½ - pound blocks. Detonating velocity is 23,000 fet per second. It is a hard, brittle, cast explosive and is a very good substitute for TNT.

a. To prime the individual M-2 block pass the time fuze through the plastic priming adapter. Then remove or puncture the paper seal, exposing the threaded cap well. Insert the blasting cap, thread, and tighten the adapter. In the absence of this priming adapter, once again substituting tape, string, wire, etc. to secure the blasting cap in the explosive.

NOTE — Have satchel of tetrytol available.

COMMENT — b. The item before now is the M-1 demolition chain. The M-1 chain consists of eight 2½ -pound blocks of tetrytol with a length of detonating cord passing through the center of each block. This assembly was designed to give front-line troops a ready charge that is adaptable to many hasty demolition projects such as quick destruction of bridges, equipment, bunkers, etc. Priming is accomplished by attaching the blasting cap (with closed end of cap toward explosive) to the detonating cord with the detonating cord clip, tape, or string. In the absence of the mentioned items, the charge may be readily primed by tying a simple overhand knot, inserting the blasting cap into the knot. This method is positive as long as close contact exists between the closed end of the cap and the detonating cord.

NOTE — Use inert training aid to demonstrate following:

COMMENT — Dual Priming: To insure positive detonation, it is recommended that all charges be dual primed. Dual priming is two independent firing systems, both capable of firing the same charge(s). Non-electric dual priming is shown here in its simplest form. It consists of two independent firing systems, both inserted in the same charge. All combat charges chould be dual primed as a minimum.

Commercial blasting caps may successfully be used to detonate military explosives by crimping one cap to the time fuze and then attaching another cap without time fuze to the original cap. This assembly is used to prime the charge.

Misfires: The next item to be discussed is misfires. A misfire is a charge which failed to detonate when it was supposed to. A non-electric misfire exists anytime the blasting cap has failed to detonate after the estimated time has elapsed. The most hazardous part of demolition work is the investigation of misfires. Remember, with a misfire, you are working with the unknown and the uncertain.

Handling Misfires: Before any non-electric misfire is investigated, a waiting period of 30 minutes must be observed.

1. Exposed charge: To handle any explosed charge after the 30-minute waiting period requires only a new primer to be inserted in the defective charge and fired.

2. Covered or tamped charge: When any charge is covered or tamped, the tamping must be removed to within a minimum of 1-foot of the charge. This is done after the 30-minute waiting period. Are there any questions?

NOTE — Students move to work tables for practical exercise.

H+ 50 to 1H — BREAK

COMMENT

1H to 1H+ 40

During the next period of instruction we will treat electric firing systems. Electric firing systems offer two advantages over the non-electric firing systems. (1) We are able to detonate a multiple of charges simultaneously. (2) We retain complete control over the exact time of detonation, however, it requires more equipment.

The electric primer differs very little from the non-electric as it consists of a piece of explosive, an electric blasting cap, and the necessary items to join these items together as one unit. When the electric power supply is connected to the primer, this constitutes the electric firing system.

NOTE — PLACE CHART No. 4, ELECTRIC BLASTING CAP, ON GTA STAND

COMMENT

Electric blasting cap: The first item of the electric firing system that I will discuss in detail is the electric blasting cap. The electric blasting cap consists of a copper or aluminum shell. This shell is fitted with two 12-foot lead wires. The lead wires pass through a filler material and an asphalt plug. The lead wires terminate inside of the igniting charge. As you noticed, the electric cap contains an intermediate charge. Immediately after the intermediate charge is the detonating charge. A small "bridge" of high resistance wire connects the ends of the lead wires together where they terminate inside of the igniting charge.

COMMENT

Function of the electric cap: The electric blasting cap will detonate when electric current is applied to the lead wires. This is accomplished by the resistance of the "bridge" wire causing the "bridge" to heat to extreme temperatures instantaneously. This heat ignites the ignition charge, which in turn ignites the intermediate charge, which in turn detonates the detonating charge. A current of .2 to .5 amps is required to cause instantaneous detonation.

Short circuit shunt: At the end of the lead wires you can see a small piece of lead material affixed to both of the lead wires and holding them together. This device is the "short circuit shunt." Purpose of the "shunt" is to produce a short-circuit, therefore preventing static electricity, induced radio frequency, high tension power lines, etc., from accidentally detonating the blasting cap.

The premature detonation of electric blasting caps by induced radio frequency (RF) currents is possible. There is a table on page 46 of FM 5-25 dated October 1963 which shows the minimum safe distance versus transmitter power and indicates the distance beyond which it is safe to conduct electrical blasting even under the most adverse conditions. Mobile-type transmitters are prohibited within 150 feet of any electrical blasting caps or electrical blasting system. Two alternative courses of action may be taken when blasting at distances less than those in the table is necessary.

(1) The first alternative is a non-electric blasting system, as there is no danger whatsoever of a premature detonation by RF current. This method should be used if at all possible.

(2) The second alternative is an electrical blasting system constructed and operated under the following rules to minimize the possibility of premature detonation by induced RF currents.

(a) Observe all electric blasting safety rules.

(b) Cover all firing wires with dirt.

(c) Use a regularly twisted wire like W-100/B or W-1TT.

(d) Twist the length of all cap lead wires when removing them from their original individual containers.

(e) Keep the number of caps to a minimum preferably one.

NOTE

As an example: You must be 6.50 feet from a 1,000 watt transmitter.

This is an item of extreme importance and must be understood and remembered. I cannot emphasize the need for this device enough.

Different blasting caps: Another extremely important point about electric firing systems, the blasting caps for the particular circuit, regardless of which kind, should be manufactured by the same company. Reason for this is that blasting caps of different manufacturers have different amounts of resistance in the "bridge" of the cap. Mixing of different caps could produce misfires. Misfires cannot be tolerated. Electric blasting caps of different manufacturers should never be mixed. This is a very important point.

Cap identification: To help prevent mixing of different caps the Ordnance Corps has provided three positive means of identification.

1. The cardboard shipping tube will indicate the name of the manufacturer.

2. In the event the tube is lost or defaced, the blasting caps are also color coded. They will be copper, blue, or red in color.

3. To be of aid in the dark, the shunt of the caps are different. It will be either round, square, or rectangular; and, in the case of the M-6 military cap, there is no shunt; but the lead wires are twisted together to act as a shunt.

Electric cap test and use of galvanometer: Before priming any explosive with the electric blasting cap, the blasting cap is tested first. To test an electric blasting cap, we use a device known as the galvanometer. The galvanometer consists of an electro-magnet, scale, indicator needle, and a battery; all contained in a plastic case. A leather carrying case is provided for convenience and protection for the device. The battery is of utmost importance as only one kind is used and it is BA 245 /U silver chloride battery. In order to detonate an electric blasting cap, .2 to .5 amps are required. The BA 245 / U silver chloride produces only .9 volts. The .9 volts do not produce sufficient amps to detonate the electric cap. If any other type of battery is used in this device, it may easily become a blasting machine rather than a testing device. Never attempt to use any other type of battery. The battery contains a positive and negative post and the RED WIRE of the galvanometer must be connected to the positive post, marked with a plus (+) sign, or the device will attempt to operate in the opposite direction. When installing the battery, leave it inside of the shipping tube. This prevents the battery from being loose and helps to absorb shock. During freezing weather, the galvanometer should be carried inside of the shirt next to the body to prevent the battery from freezing, as this will cause an inoperative galvanometer.

Before using the galvanometer, make sure the device is functioning properly by crossing the terminals on top with any object that will conduct electricity and at the same time observe

the indicator needle. A wide deflection should be observed. If this indicator needle does not move or moves only slightly, inspect for loose connections and or replace the BA 245 U silver chloride battery. Once it has been determined that the galvanometer is not defective, test the blasting cap in the following manner. First, remove the "short-circuit shunt" by grasping the lead wires in one hand and the shunt in the other and pull vigorously. Inspect the lead wires to insure that the varnish on the wire ends have been removed. Next, place one of the lead wires to either post of the galvanometer. The remaining lead wire is placed on the other post. The indicator needle is observed and a wide deflection of the indicator needle should be noticed. If no deflection of the needle is noticeable, the blasting cap is assumed to be defective and is to be treated as a dud. The ends of the lead wires are twisted together to produce a short. A cap is then placed in a charge primed with another blasting cap, and this charge is detonated. A defective cap is never left unattended or cast aside. They are still dangerous and may, like any other "dud," be detonated if abused. If the cap is determined to be serviceable, then twist the ends of the lead wire together to take place of the shunt. Are there any questions?

NOTE

Use inert explosives and demonstrate priming of the following:

COMMENT

Electric priming: The instruction will continue by a demonstration of electric priming of various explosives.

1. Priming of TNT:

a. When priming the TNT block with the plastic priming adapter, insert the lead wires through the slot of the adapter insuring the threaded end is nearest the blasting cap, and insert the blasting cap into the cap well. Thread and tighten the adapter. The block of explosive is now ready to use.

b. When the adapter is not present, merely break or puncture the paper seal over the cap well and insert the blasting cap. To prevent the seal of the cap from becoming cracked or the lead wires from being broken, take up a small amount of slack at the cap and tie two half-hitches or a girth hitch around the block of explosive.

2. Priming of composition C-4:

a. When in the block form, C-4 is primed much like TNT by first producing a priming well in either end of the block and inserting the blasting cap. Once again the half-hitch or girth hitch method is used to secure the blasting cap to the explosive.

b. To prime C-4 in the molded form, produce a priming well at any convenient location and insert the blasting cap. The cap is secured to the explosive by any feasible means. Try to maintain ½-inch of explosive on all sides of the blasting cap and 1-inch at both ends. This is necessary to insure positive detonation.

3. Priming of tetrytol:

a. The M-2 block is primed by placing the cap in the priming well and securing with the priming adapter or half-hitch method in the same manner as TNT.

b. The M-1 chain is primed by attaching the blasting cap to the detonating cord in the same manner as non-electric priming.

4. Priming of dynamite: Dynamite is primed by producing a priming well in the "star-crimped" end of the stick, insert the blasting cap and secure with half-hitches or a girth hitch. Remember to maintain slack in the lead wires between the "half-hitches" and the blasting cap.

COMMENT

Firing Wire: Now that we have seen how to prime the various explosives with the electric blasting cap, I will discuss the next portion of the electric firing system and that is the firing wire. The firing wire allows individuals to be at a safe distance from any charge or charges that are to be detonated electrically.

NOTE

At this time produce the issued-type firing wire and explain the following:

COMMENT

The issued firing wires come in 500 and 1,000 foot rolls. It is a simple two conductor No. 18 AWG copper wire with rubber insulation. Reels are supplied for recovery and storage of the wire. Before the firing wire is laid from the charges to the operators position, it is checked for continuity. To accomplish this we use the galvanometer and it is performed in the following manner. Twist both wires of one end together. Place the wires of the other end to the posts of the galvanometer. A wide deflection of the indicator needle should be noticed. If no movement is noticed, a break exists in the wire. The second step consists of opening the end of the wire and repeating the galvanometer test. This time no movement of the indicator needle should be visible. If movement is present, an opening exists in the insulation allowing the two conductors to make contact and producing a short circuit. In both cases on-the-spot corrections must be made. Next, the firing wire is laid from the charges to the firing or operator's position. Once again the continuity test is made. Reason for performing the original test is to discover any defect prior to laying the wire. Reason for the second test is to detect any defect that was not noticed during the first test.

NOTE

Demonstrate arm and hand signals used during second test.

COMMENT

One end of the firing wire is always twisted together when the wire is not in use. This provides a short circuit which prevents static electricity, induced radio frequency, etc., from accidentally detonating any charges that may be attached to the firing wire.

Firing circuits: When any multiple of charges are to be fired simultaneously, the various charges must be wired together in some sort of system. The various applications of this are referred to as electric circuits. Today we will discuss only two circuits.

NOTE

Place chart No. 6, common series, on GTA stand

COMMENT

Common series: The first circuit that I will explain is the common series circuit. When all charges have been emplaced, the circuit is wired in the following manner. Take one lead wire from one of the charges, preferably one nearest the firing wire and splice it to a lead wire of the next charge. The remaining lead wire from the second charge is spliced to a lead wire from the next charge. This process is carried out until all charges are joined together leaving only two charges with one lead wire apiece. These lead wires are joined to the firing wire, a continuity test is made of the circuit.

At any time the lead wires are not of sufficient length to reach the other lead wire on the firing wire, use annunciator wire for extensions. (Produce annunciator wire and demonstrate the following.) The annunciator wire is a single copper conductor No. 20 AWG and is issued in 200-foot rolls. In the absence of annunciator wire, WD1 and other wires may be used but should be kept to a minimum. Wire of different types and gauges may present abnormal resistance to the electric current which may result in misfires.

NOTE

Place chart No. 6A, leapfrog, on GTA stand

COMMENT

"Leapfrog" circuit: The remaining circuit I will explain is the "leapfrog" circuit. This circuit is wired by joining the lead wires of every other charge until the last charge is reached, then returning through the circuit and splicing the remaining wires together. The big advantage in this circuit over the common series is that the leapfrog circuit conserves wire.

NOTE

Place chart No. 7, Western Union pigtail splice, on the GTA Stand and explain the following

COMMENT

Western Union "Pigtail" Splice: During the explanation of the two electric firing circuits, I have mentioned splicing on several different occasions. This is a very important point as only one type of splice is used. And it is the Western Union "pigtail" splice. This splice is made by removing the insulation from the ends of the wire for a distance of about 3 to 4 inches. The ends of the exposed wire are brought together and twisted about themselves three or four times. The ends are then bent to 90 degrees of the wire and twisted about themselves three or four times again. Then the entire splice is compressed together. If the firing circuit is to be in place for any extended period of time or is to be used during wet weather, the splice must be protected by type and/or waterproofing compound. When the firing circuit will be in place for a very short time and the weather is dry, this extensive work is unnecessary. The paper shipping carton for the electric cap may be slipped over the splice to hold it off the ground. The shipping carton is crushed flat to prevent wind, etc., from blowing it off the splice. All splices should be made by one

individual only. This has two sound reasons: (1) It prevents any charges being omitted from the circuit. (2) All the splices will be almost identical, therefore presenting about the same amount of resistance in the circuit. This has a direct effect on the amount of misfires.

Blasting Machines: The U.S. Army issues four types of blasting machines: (1) The ten-cap machine; (2) The 30-cap machine; (3) The 50-cap machine; and (4) The 100-cap machine. The name indicates the maximum number of blasting caps the machine will safely detonate. The 10-cap machine is the most widely used and is the only type that will be shown here today.

NOTE — Produce the 10-cap machine and demonstrate the following:

COMMENT — This blasting machine is an impulse generator capable of detonating ten electric caps. It is operated by a "T" handle crank. Two terminals are located on top to connect the firing wire. Before the blasting machine is used, it should be warmed up by operating the crank several times prior to connecting the firing wire. Also, before the machine is connected to the firing wire, a continuity check is made of the entire circuit with the galvanometer. A word of caution on the blasting machine; when working with electric circuits, the blasting machine is kept on the person of the demolition chief or a responsible person he designates. This prevents some irresponsible person from firing the charges prematurely which may result in death or injury to some individual.

Alternate Power Supplies: Vehicle batteries, radio batteries, BA 30's, etc., may be used as substitute power supplies in the absence of a blasting machine.

Electric Misfires: Electric misfires are handled in the same manner as non-electric with one exception. If the charge is not tamped or covered, the misfire may be investigated immediately. If the charge is tamped or buried, the 30-minutes waiting period is in effect.

Dual Electric Priming: The best method of preventing electric misfires is to insure that all splices are made the same plus dual priming. Electric dual priming is similar to non-electric since it consists of two independent firing systems, both capable of firing the same charge(s). Are there any questions on electric firing systems?

NOTE — Students move to work tables for P.E.

1H+ 40 to 2H — Coffee Break

COMMENT

2H to 2H+ 50

Detonating Cord Firing System: This period will be devoted to the detonating cord firing system. This system offers greater flexibility in detonation of several charges simultaneously since the detonating cord firing system may be primed electrically or non-electrically. Conservation of blasting caps is possible as only one cap is needed to fire several charges.

NOTE — Show detonating cord at this time

COMMENT — Detonating cord is issued in 50, 100, 500, and 1000-foot spools. It may be white or yellow and black. White is seen most often but an O.D. color is being developed. It consists of a seamless tube of waterproofing material containing an explosive train of PETN. This material does detonate and it is an explosive item. A special blasting cap, electric or non-electric, is required for detonation. Being a military explosive item, it is insensitive to shock, heat, or friction, and is not liable to detonation by small arms fire. The detonating velocity of this material is 21,000 feet per second, the same as TNT. Keep in mind that a blasting cap is needed to detonate this material.

NOTE — Fire detonating cord for demonstration

COMMENT — In demonstrating the manner to construct a detonating cord firing system, I will first cover the methods of priming various types of explosives with a length of detonating cord. The length of detonating cord used to prime the various pieces of explosives is referred to as the branch line. Required length of the branch line will be clear later in the instruction.

NOTE — Produce branch line and demonstrate the following:

COMMENT — 1. Priming of TNT: TNT is primed by tying a "clove-hitch" plus two extra turns around the block of explosive with the branch line. The knot must be dressed out until it is very tight and solid. A minimum of four wraps is required around the block to insure positive detonation. An extension of 6-inches must protrude past the knot.

2. Priming of Composition C-4:

a. When in the block form, C-4 is primed with the "clove-hitch" method like TNT or lace primed such as will be explained in the priming of dynamite; however, these two methods are not a means of positive detonation. These two methods may merely break the explosive and throw it through the air without 100 per cent detonation. The best method for priming C-4 with detonating cord is as follows:

b. When in the molded form, C-4 is primed by opening the mold. Next, tie a simple overhand knot after taking about a 10-inch bight in the detonating cord. Insert the knot into the mold, close and compress the explosive firmly around the knot. Attempt to maintain ½-inch of explosive on all sides of the knot and 1-inch on either end of the knot.

3. Priming of Dynamite: Dynamite is primed by making four holes through the diameter of the stick. The detonating cord is threaded through the holes. A knot is tied where the detonating cord passes through the last hole. A 6-inch extension should protrude past the knot.

4. Priming of Tetrytol:

a. The individual M-2 blocks are primed with the "clove-hitch" plus two extra turns. But with this explosive the knot must be placed within 1-inch of the end of the block. The reason for this is that tetrytol contains a booster of tetryl surrounding the cap well on either end of the block. The knot must be placed directly over the booster to insure positive detonation.

b. The M-1 chain is primed by attaching the branch line to the detonating cord of the chain by using a square knot.

Now that we have seen how to use the branch line to prime various explosives, I will demonstrate how to join these branch lines together in order to fire several charges simultaneously.

NOTE Place chart No. 9, main line, on GTA stand

COMMENT Main Line System: The simplest form of joining the branch lines into one system is the main line system. The main line consists of a length of detonating cord running through the area where the demolition is to be performed. This length of detonating cord may be straight or curved, and there is no limitation as to the length. The primed charges are emplaced and the branch lines are connected to the main line at any point along the length and from either side. Methods of attachment will be demonstrated in subsequent instruction. The main line is then primed from either end, electrically or non-electrically, but two important points must be observed. (1) The blasting cap must be attached at least 6-inches from the end of the detonating cord. (2) The closed end of the cap must point toward the charges. The main line has one disadvantage. If the main line should become broken or cut any place along its length, all charges past this point are isolated and will not be detonated. The simplest way to overcome this disadvantage is to use another system which is more reliable, but keep in mind that the main line is a very good system to use in rear areas.

NOTE Place chart No. 10, ring main, on GTA stand

COMMENT Ring Main: This brings us to the next system which is the ring main. The ring main starts out very similar to the main line except the running end circles around and is attached back to the standing end. Then the charges are attached and the ring main is primed. The ring main is the most reliable of these two systems.

NOTE Demonstrate reliability of the ring main system using training aid to demonstrate the following:

COMMENT Only three knots are used with the detonating cord system. They are as follows:

1. The square knot.
2. Three round turns and half-hitch.
3. Modified girth hitch.

The described knots assure us of positive detonation. These are the only knots that should be used.

Several precautions should be exercised with any detonating cord firing system to insure positive detonation of all the charges. They are as follows:

1. Closed end of blasting cap is always pointed toward the charges.

2. The detonating cord is never allowed to kink, cross, or touch itself.

3. Use only the knots demonstrated and insure that the knots are tight.

4. Angle between ring main or main line and branch line should be at least 90 degrees.

COMMENT

Dual Priming: Dual priming a detonating cord firing system consists of attaching two independent firing systems to the ring main or main line.

Detonating Assembly: Next, I will demonstrate an item of utmost importance; the detonating assembly. This item is constructed by the dual priming of a 2-foot length of detonating cord. When the detonating cord is dual primed non-electrically, make sure the blasting cap nearest the end contains the shortest length of time fuze and during use the same fuze is ignited first. The reason for this is so this cap will detonate first and, if defective and only cutting the detonating cord without producing detonation, the "back-up" cap is still effective. If the situation was reversed, you readily see that the second or "back-up" cap would be isolated from the charges resulting in a malfunction. Reason for constructing the detonating assembly is to provide speed and control. I want to discuss this matter of speed and control. First, should we be concerned with speed? The assembly could be constructed in a rear area, therefore saving time on the target as there is no need to crimp caps, etc., also, to attach the detonating assembly to the ring main or main line requires only one square knot. This saves considerable time on target which is very important on any raid-type mission. Being constructed in a rear area and carried by one responsible individual prevents the system from being detonated accidentally or prematurely by some incompetent or "nervous" type individual. I want to impress you with the advantages of speed and control provided by the detonating assembly.

NOTE

Place chart No. 10, dual non-electric firing system on GTA stand.

COMMENT

Dual Non-Electric Firing System: This chart indicates how we may dual prime a multiple of charges non-electrically. The method demonstrated before limits us to one charge only.

NOTE

Place chart No. 11, dual combination firing system, on GTA stand.

COMMENT

This chart shows the dual combination firing system. It consists of an independent non-electric firing system and an independent electric firing system. In this case the time fuze is ignited first and in the event that there is a misfire or for some reason there is a necessity to fire the system prior to detonation by the non-electric means, the electric system is used to detonate the charges.

Gentlemen, this concludes the instruction on non-electric, electric, and detonating cord firing systems. Are there any questions?

At this time I want to re-emphasize a couple of important items:

1. Burning rate of time fuze.
2. Crimping caps.
3. Misfires.
4. Testing electric blasting caps.
5. Don't mix caps of different companies.
6. One man to do all splicing.
7. Proper knots of detonating cord systems.
8. Don't let detonating cord kink or touch itself and attachment of caps.
9. Use of detonating assembly.

NOTE	Students move to tables for P.E.
2H+ 50 to 3H	BREAK
COMMENT 3H to 4H	Class, may I have your attention. I am ______________, the principle instructor for the next unit of instructions. During this time we will be concerned with the mine, anti-personnel, M18 and M18A1 (claymore). Reference material for the mine is TC 7-3 dated 10 October 1962. Possibly many of you are wondering how the name claymore became attached to this weapon. Contrary to common belief, it is not named in honor of a man. The dictionary defines claymore as "a two-handed Scottish broadsword capable of cutting a wide path through massed enemies." With this in mind, shall we take a closer look at the U.S. Army "broadsword." In Viet-Nam, at the present time, the claymore mine is issued in large amounts to the combat arms. It is a very effective weapon and many of you shall encounter it while serving in that country. The M18A1 is packed one complete weapon to a bandolier. Six of these bandoliers are placed in a wooden box.
NOTE	As the following is demonstrated, place items on table in view of class.
COMMENT	Examination of the bandolier will produce one weapon, one detonator assembly, and one firing device. There is one exception; one of the six bandoliers will contain an M-40 test set. This bandolier will be marked with a green tag on the carrying strap.
NOTE	Use large mock-up to explain each component.
COMMENT	At this time I will return to each item and explain it in a little more detail. 1. Mine, anti-personnel, M18A1: The mine is a curved rectangular box of plastic. The convex side contains the 700 spherical steel balls and the concave side contains C-4 which is the propellent. The weapon is covered with a dull green fiber material for camouflage. Two scissor-type legs are provided. Two priming wells are located on the top with the sight resting between. 2. Detonator assembly: The detonator assembly is nothing more than 100 feet of firing wire with a standard electric blasting cap on one end and a dust cover on the other. The dust cover is a shorting plug also. This acts in the same manner as the "shunt" of an electric blasting cap. 3. Firing Device, M-57: This is a one hand operated impulse generator. On top is an actuator handle; to the rear and below the actuator is the safety bail. This firing device will produce three volts.

4. M-40 Test Set: The test set consists of a transformer and a small indicator lamp. A window is provided to view the lamp.

NOTE — Use charts to explain the following effects of the M18A1 and M18; cover safety factors also.

COMMENT — Before we can successfully employ the weapon, we must understand the effects of the mine. When fired, the M18A1 projects the 700 steel fragments forward in a fan-shaped, beaten zone, 2-meters high and 50-meters wide at a distance of 50-meters. This area is known as the killing zone. Within this area any of the steel fragments are capable of penetrating the U.S. Army armored vest. It is moderately effective to a range of 250-meters. The latter area covers an arc 90 degrees to the right and left of the center of the killing zone.

Safety Factor: This weapon has a danger area to the rear. This danger area exists from the concussion of the C-4 filler used to propel the fragments and missiles that are picked up by this concussion. This fact must be fully understood in order to safely employ the weapon.

NOTE — Use chart and give safety factors as follows:

COMMENT — The first section of the danger area is a 180 degree semicircle with a radius of 16-meters. All friendly personnel are prohibited in this area when the mine is detonated. The other section has a radius of 100-meters. All friendly troops within 100-meters must take cover when the weapon is detonated.

NOTE — Use chart M-18 to demonstrate the following:

COMMENT — The M18 is less effective than the M18A1. The killing zone of the M18 is 2-meters high, 30-meters wide at a distance of 30-meters. It is moderately effective to a range of 40-meters. It can be dangerous to a range of 205-meters.

From a distance of 0 to 8-meters to the rear and sides all personnel are prohibited. Everyone from 8 to 42-meters must take cover. Between the range of 42-100-meters exposed personnel need only to shield their face.

Employment of the claymore is placed in two broad fields: As a controlled weapon and the role of an uncontrolled mine. The role as a controlled weapon will be discussed first.

Keep the killing zone and danger areas in mind when selecting the point of detonation. Once the location has been chosen, remove the mind from the bandolier and spread the legs. Bury the legs about halfway in the ground and face the weapon toward the desired field of fire. The front of the weapon may be determined one of three ways:

1. Letters on the face read "front toward enemy..."
2. The front is convex which is helpful at night.
3. An arrow located on each top corner.

Start in front of the weapon and pace off a distance of 50-meters for the M18A1 and 30-meters for the M18. At this point, drive a stake 1-meter high into the ground. Return to the weapon and with

the eye about 6-inches from the sight, lay the cross hairs of the sight on the aiming stake. The vertical cross hair must pass through the center of the stake with the horizontal cross hair resting on top of the stake. CAUTION: The sight of the M18A1 contains two clear plastic faces and each face has a separate cross hair. These must be superimposed so they appear as one object at all times during aiming operation. The weapon is now sighted.

Insure the shorting plug and dust cover of the detonator assembly are installed at all times. Remove either priming well plug and insert the blasting cap. Insert the electric cap in the well and the wires in the "V" slit of the priming well plug, thread, and tighten the plug. Tie the firing wire to some object to prevent the wire from being pulled and disturbing the lay of the weapon. Recheck aim and camouflage. Lay the firing wire to the operator's position. Insure safety bail is in the safe position, then join firing wire to the firing device. The weapon is ready for use.

At any time a continuity test is desired, either during initial employment or afterwards, it is accomplished in the following manner. Remove firing device from the firing wire and reinstall shorting plug of the firing wire. Connect test set to firing device. The dust cover on the test set must be installed. Observe the window and operate the handle. A brief flash of light should be visible in the window. Attach the firing wire to the test set and repeat the operation. The weapon will not detonate as long as the test set is installed in the circuit. At any time the flash fails to appear, use the process of elimination by replacing either the firing device or test set to locate the faulty equipment. A continuity test must be made periodically and after heavy rains or bombardments.

Once the test has been completed, remove the test set from the circuit and replace the firing device making sure the safety bail is in the safe position before installation.

The weapon may be fired non-electrically also by crimping a non-electric cap to a length of detonating cord. This is used to prime the weapon. Lay the detonating cord back to a position near the operator. Here another cap is crimped to an M-1 pull-type firing device and then taped to the free end of the detonating cord. The firing device is attached to some steady object. A wire or stout string is tied to the pull ring and run to the operator's position. To fire the weapon only requires a strong pull of the wire. The firing device will detonate the detonating cord causing the weapon to fire. It is recommended that the weapon be primed electric and non-electric. The claymore may also be dual primed electrically by using the common series or "leapfrog" system. Also, several claymores may be fired simultaneously by using one of these systems.

NOTE — Use charts and Demonstrate how weapon is employed in a defense and in an ambush-type role.

COMMENT — The claymore is an excellent weapon for an ambush-type role. On this chart we see one claymore placed in a curve of a jungle trail. When the enemy is within the killing zone, the weapon is detonated. Another version is two claymores placed on opposite sides of a trail or road. The long axis of the killing zone runs parallel to the trail. The mines are wired separately and when the enemy approaches one of the weapons detonated. The other is saved in the event that the group fired on was only a lead element or they apply immediate action and attack. At this time the second weapon is fired, causing several more changes to the Viet Cong morning report.

Due to the fact that this weapon is a one-shot directional-type weapon, fire discipline assumes a paramount importance. Control of the weapon must always be in the hands of a competent individual.

NOTE — Use chart to show proper time of detonation when a group is approaching abreast, in file, or in a group.

COMMENT — The claymore may be used in a defensive role as protection to hamlets or units in camp. Employment to reinforce wire entanglements and to cover dead spaces is extremely worthwhile. When the weapon is emplaced in this manner as a booby-trap, it is wired with the same device as was used to fire the weapon non-electrically except the pull wire of the firing device becomes a trip wire.

NOTE — Use chart to demonstrate two methods of employing the claymore as a booby-trap or land mine.

COMMENT — Any time the weapon is employed in the uncontrolled role as a land mine, it must be marked, located, and reported the same as any mine field.

NOTE — Using GTA, explain mass employment of the claymore.

COMMENT — To obtain maximum coverage of a large front, the claymores are more effective when placed on line with a separation of 15-meters. The weapons that are placed in depth must be separate by a distance of the backblast area. This is 8-meters for the M18 and 16-meters for the M18A1. Also, the front row of weapons must be fired first. It may be desirable to provide means to detonate a large segment of the line at one time. This is accomplished easily with a common series or ring main detonating cord firing system.

COMMENT

Gentlemen, as you see, the claymore is a very effective and versatile weapon. The employment of the claymore can be a deciding factor in this very simple war. Our advice to these people may have direct influence on its employment. Are there any questions?

ARVN Mine Policy: As preparatory background the mine policy of ARVN will be discussed at this time. When a mine field is desired, the company commander draws up a request showing the desired location of the mine field. The request is forwarded to the district headquarters. The district chief inspects the location of the mine field to insure that it will not endanger cattle, wells, or the farming area, etc. After this inspection, the request is sent forward to the province chief. In the event the district chief is not a military officer, his aide who is an officer will handle the requests. The province chief must approve the requests. Then the engineers install the mine field. The engineers perform all work involving the actual mines, but the occupying unit must maintain all the fences, markers, etc. Are there any questions?

Munroe Theory: While observing the demonstrations this afternoon, you shall hear mention of the "Munroe Theory" several times in reference to the mechanics of several charges. At this time I will explain the theory and how this theory led to the invention of the shape charge. A chemist by the name of Munroe used three theories to develop these charges:

1. A force will cancel or repel an exact opposite force.
2. Force takes the path of least resistance.
3. The shock waves leave a detonating explosive at a 90 degree angle to the surface of the explosive. The latter is the Munroe Theory.

NOTE

Use GTA to explain the following:

COMMENT

By placing two equal pieces of explosives together in such manner to form an inverted V and detonating them at the apex of the V, the detonating waves on the inside of the V will strike each other at the center of the V-shaped cone. Being of almost exact likeness, they tend to repel each other and travel at a downward angle, hence, the first portion of the theory comes to view. This action happens all the way down the cone simultaneously; a reinforcing effect results. A small jet of energy is formed and is projected downward at tremendous speed. Velocity of the "jet" stream formed by the M-3 40-pound shaped charge is 73,000 feet per second.

When any charge involving the Munroe Theory is used to penetrate concrete or steel, another element comes into effect; this effect is known as standoff. Standoff has a direct bearing on the effectiveness of the charge. The minimum standoff for maximum effectiveness is found to be at 90 degree measure from the side of the cone using the lower as a pivot. A measurement is taken from the opposite corner and the distance at which these lines intersect is the minimum standoff. In order to fully understand several of the charges that will be demonstrated this afternoon, you must first understand this principle.

LUNCH BREAK

COMMENT

4H to 4H + 40

Expedient Use of 3.5" Rocket Round: The 3.5" rocket provides an excellent weapon for ambushes, defense of hamlets, to cover dead spaces, area coverage, and to reinforce barbed wire entanglements. It is easily fired without the launcher. You will discover that the 3.5" rocket is a very versatile weapon.

NOTE

As each type of improvised launcher is explained, place in view of the students.

COMMENT

1. A very good launcher for the rocket is the cardboard package that the rocket is shipped in. The cardboard container has one disadvantage in that rain and moisture will cause separation of the paper. For this reason, we will move on to the second type of launcher which is not readily affected by moisture.

2. The metal container which surrounds the cardboard tube is a fine launcher provided that both ends are removed. Both of these launchers may be readily attached to trees, stakes, posts, etc., for firing.

3. Improvised launchers may be constructed from boards and planks. The crate that the rounds are shipped in may be disassembled and used quite readily. Construction consists of building a "V-shaped" trough twice as long as the rocket. Legs may be attached to the front of the launcher to aid in elevating and sighting.

Sighting equipment may be fabricated from the cardboard container and a length of string. To fashion the sight, cut four notches spaced 90 degrees apart around the end of the tube. Lengths of string are placed thru the notches, forming a set of "cross hairs." Halfway between the horizontal cross hair and the lower outside edge of the container, a second horizontal cross hair is placed. The wooden plug with the small hole in the center is left in the container. To use the sight, place it on the launcher with the cross hairs forward. The two horizontal cross hairs are nearest the ground. Sight through the small hole in the wooden plug and aim the cross hairs on the center of mass of the target. The middle cross hair is for sighting at ranges of 50-yards, the lower cross hair is for sighting at 100-yards, and the bottom edge of the tube is for sighting at 200-yards. Any range between will be "Kentucky" windage and "Tennessee" elevation. Launching rockets by this means is not effective for ranges of more than 200-yards; use the WAG system.

I will now explain the means of firing the rocket by improvised methods. Improvised firing may be accomplished by two methods, electrically and non-electrically. I will explain the non-electric method of firing first.

NOTE

Use a rocket to demonstrate.

COMMENT

Insure that the safety band is in place. Remove the wires found in the rear of the rocket motor. (Red, green, blue, and clear.) Use a non-sparking tool, remove the plastic cone that

closes the venturi of the rocket. After the plastic cone is removed you will see a grate inside the venturi of the rocket. Cut some heads from matches and pour them into the venturi onto the grate. Cut a piece of time fuze and tape or tie a few matches to one end of it so that the heads are exposed to the fire from the end of the fuze. To fire the round, place the rocket on the launcher with the bore-riding safety pin depressed; insert the time fuze with the matches on it into the venturi. Attach a fuze lighter, ignite the fuze, and take cover out of the backblast zone of the rocket.

The burning time fuze will ignite the matches when the fire reaches the end of the powder train. This in turn ignites the match heads previously placed in the rocket. This causes the propellent to burn and the rocket is propelled toward the target.

Firing the 3.5'' rocket electrically offers two advantages over non-electric firing in that it is quicker and easier to emplace, and we have control over exact firing time. Preparation of the rocket consists of identifying the wires in the rear of the fin assembly. The BLUE WIRE is disregarded and may be cut off and thrown away to prevent a mistake. Further examination will disclose two clear wires. One is connected to a green wire and one is connected to a red wire. These two colored wires are cut off near the support ring. The insulation of the clear wires is then removed for a length of about 1½ -inches. The wires are then shorted together. The launcher is then emplaced and is sighted in the same manner as the non-electric launched rocket. Make sure that the bore-riding safety pin is placed on the launcher so that it is in the depressed position. A firing wire is laid from the proposed firing site to the site where the operator will be under cover. The firing wire is attached to the clear wires, with a rolling twist. CAUTION: Do not use the "Western Union pig-tail splice." One and one-half volts of electricity are required as a minimum to fire one rocket.

Several rockets may be fired simultaneously by wiring them in series. Emplace the rocket launchers and sight them in. Prepare the rockets for electrical firing and place them on the launchers. The method of wiring them is the same as a common series circuit. Launchers should never be placed closer than 10-feet. Connect one of the firing wire leads to one of the clear wires of the nearest rocket. Connect the other clear wire, using a short length of wire to the second rocket; connect this rocket to the next in the same manner, and so on down the line until all are connected. The last rocket will have one clear wire remaining to be connected to the firing wire if the wiring has been accomplished in the correct manner, thus establishing a common series circuit. CAUTION: The firing wires should always be shorted to prevent premature firing.

The 3.5'' rocket may be used to supplement fires when in the defense or to add effectiveness to an ambush. The rocket may also be used as a booby trap. Their utilization is varied and depends only on the imagination of the individual using it.

The fragmentation area of the 3.5'' rocket is 10-yards wide and 20-yards long.

The rocket head may be used as a shaped charge by unscrewing the motor and fuze assembly from the rocket head. Stand the rocket on its nose and prime the fuze end of the head by placing a piece of C-4 about the size of a golf ball into the cavity which is left when the head is unscrewed from the fuze portion of the rocket. Insert a non-electric or electric blasting cap approximately ¼-inch into the C-4 and detonate. The shaped head of the 3.5'' rocket may also be detonated by placing a primed ½-pound block of TNT on the fuze end of the head. Use in this manner does not detract in the penetration of the round of upwards of 10.5-inches of armor plate.

U.S. Landmines: Description of arming and laying of the M-14 and M-16 antipersonnel mine is demonstrated.

The first mine that will be explained is the antipersonnel, non-magnetic M-14.

NOTE — As the following is explained, use an inert M-14 mine and chart to point out nomenclature.

COMMENT — The M-14 mine is a simple device of plastic construction except for the firing mechanism which is metal and for all purposes is non-detectable by magnetic detector systems. The firing mechanism is an integral part of the mine. The cylindrical body contains a plastic rotating pressure plate which is marked with an arrow. The body is labeled with an A and S indicating armed and safe positions. Color of the entire mine is an olive drab. The M-14 contains three safeties. The first is the safety clip which prevents depressing of the pressure plate. The second is the safe position of the pressure plate. Third is the detonator removed. Total weight of the mine is 3½-ounces. The tetrytol explosive filler weighs 1-ounce. It is designed to inflict a non-lethal wound. The only detonator well is located in the bottom of the mine. No secondary fuze wells or means of booby trapping have been provided.

NOTE — Use an inert M-14 and explain the following:

COMMENT — Arming and Laying:

1. Remove the mine from its cardboard shipping container and remove the white shipping plug.

2. Insure the safety clip is properly installed, then rotate the pressure plate to the "A" position.

3. While observing through the detonator well, slowly remove the safety clip. If the firing pin remains in the unfired position, the mine may be considered satisfactory for use. If the firing pin does not remain in the unfired position, do not use the mine; treat as a dud and destroy the mine as outlined in TM 9-1900.

4. Inspect end of the shipping plug for any distortion as this is evidence of an abnormal firing pin. This is a dangerous condition if the detonator is forced against the firing pin during installation and detonation of the mine is highly possible.

5. Remove the detonator from its holder and inspect for damage. The red end must be visible. Thread this, assemble into the detonator well, and tighten. The fuze and mine wrench M-22 is used for this. The detonator is shipped in the same box but separated from the mine.

6. Place the mine in a small hole with the pressure plate slightly above ground level. If the ground is unstable, place a non-metallic object beneath the mine to provide a hard bearing surface. Anchor the mine in place with the carrying cord. This prevents the mine from floating above the surface of the ground in case of heavy rainfall.

7. Hold the mine firmly without causing pressure on the pressure plate, rotate the pressure plate in a clockwise direction till the arrow moves from "S" to "A" position. The M-22 mine and fuze wrench is used for this purpose.

8. Slowly and carefully remove the safety clip and save for possible disarming in the future; carefully cover and camouflage the mine.

The M-14 mine can be used for protection around your camp at night and it can also be used at night when you are on patrols. You can put them out at night and pick them up the next morning and move on. They may also be used around hamlets for protection from the Viet-Cong.

The next mine I will explain is the M-16 antipersonnel bounding-type mine.

NOTE

Use inert M-16 mine and chart to demonstrate the following:

COMMENT

General description: The M-16 is a highly effective bounding fragmentation-type mine. The entire mine is olive drab with yellow markings. The M-16 is housed in a shell container of cast iron and is completely waterproof. Because of the metal used in construction, it is highly detectable by magnetic detection devices. Only one fuze well is provided and it is closed with a shipping plug. Total weight of the M-16 is 8-pounds. The M-605 pressure pull fuze is used to activate the mine.

Installing and Arming:

1. Remove shipping plug (use M-25 mine and fuze wrench) and inspect the fuze well and flash tube.

2. Examine the M-605 pressure pull fuze insuring that the safety pins are installed. Then install fuze in the mine and tighten.

3. Dig a hole where the mine is to be installed. The hole should be about 6-inches deep and 5-inches wide. Place the mine into the hole and insure that the prongs of the M-605 fuze protrude above ground level.

4. Fill the cavity around the mine with the spoil removed from the hole and pack firmly around the mine. Continue filling and packing till level with the bottom of release firing pin ring. This mine may be installed for pressure activation or trip wire activation or a combination of both. For the purpose of today's instruction, we will discuss both.

5. Next, drive two anchor stakes at a distance of about 30 to 35-feet from the mine and in such fashion as to form a wide "V." Secure separate trip wires to the anchor stakes and attach to the release pin ring of the fuze. CAUTION: Never install trip wire taut enough to exert pull on the release ring pin.

6. The next step is to remove the interlocking safety pin, place the pull cords in a position for easy removal. Camouflage the mine and its location. By use of pull cords, remove the locking safety pin. CAUTION: If the positive safety is hard to remove, this indicates that the striker is partially activated, and complete removal of the positive safety will allow the striker to continue its downward travel and detonate the mine.

Functioning: When the M-605 fuze is activated by pressure on the prongs or by the trip wire, a delay fuze begins to burn. This allows the person that activated the mine a brief moment to move a couple of steps in order that the mine may bound into the air. The fuze is set so that a pressure of 8 pounds and no more than 20 pounds is needed to activate the fuze. Pull pressure on the trip wire is set from no less than 3 pounds and no greater than 8 pounds for activation. After the fuze delay burns for a brief period, an expelling charge projects the cast iron shell and its bursting charge into the air. When the cast iron container reaches a height of 2 to 4 feet above ground, its charge is detonated by two delayed detonators and the area is covered with shrapnel. The effective casualty radius is 35 yards. The M-16 may be dangerous to a range of 200 yards.

COMMENT

TIMBER CUTTING, STUMPING, AND DITCHING

4H + 40 to 5H

The following instruction consists of timber cutting, stumping, and ditching. This will better enable you to advise the Vietnamese how to employ demolitions to clear fields, for farms, LZ's and DZ's, and roads. It can be of great help in building villages also. The ditching principle taught here will enable you to assist these people in construction of canals and the moats that surround the strategic hamlets.

Timber cutting involves two basic formula; one for an internal charge and the other for an external charge. The internal charge conserves on explosives. Due to the fact that you will not encounter resupply problems on demolitions and drills are required to place an internal charge, we will concern ourselves with the externally placed charge only.

NOTE

Use timber cutting formula to explain the following:

COMMENT

The external untamped formula is P equals D^2 over 40. Explanation of the formula is as follows: P stands for the pounds of TNT which is the unknown that we desire to obtain. D^2 is the diameter of the timber, expressed in inches, multiplied by itself in order to square the number. Forty is a constant number that appears each time in the formula. I will work the formula using the arbitrary number of 12 for the diameter. Hence, P equals to 12 times 12 over 40. In the next step, P will equal to 144 over 40. This will reduce to 3 34 /40, which is rounded off to 4 pounds. Any time the answer is a fraction, round off to the next higher ½ pound. The answer is always in pounds of TNT.

NOTE — Use GTA 5-14, demolition card, to explain relative effectiveness factors.

COMMENT — Once the amount of explosives needed is computed, it must next be attached to the timber. For best results, the explosive should completely encircle the timber when practical. When it is desired for a timber to fall in a particular direction, the center of the charge is always placed on the same side as the desired direction of fall. The detonating wave of the charge will push the butt of the tree in the opposite direction, causing the tree to lean and fall toward the desired direction. This charge may be used to cut any shape timber (square, rectangular, round, etc.). Are there any questions?

Experience has taught many advisors that this timber cutting does not always succeed on teakwood and mahogany. Experience has also taught that the best method on these trees is to remove tree, stump, and roots in one operation. With this in mind, we will go into stumping methods.

The first step in stumping operation is to determine the amount of explosive needed. To accomplish this, we use a rule-of-thumb as follows:

1. Dead stump--1 pound per foot of diameter.
2. Green stump--2 pounds per foot of diameter.
3. For a tree and stump--use 3 pounds per foot of diameter.

This will yield the amount of explosives for a test shot. If it is found to be over or under charged, adjustments are made.

NOTE — Use charts to explain the following:

COMMENT — In the next step we must decide on placement of charges. Placement of the charges will depend on the root structure. There are two basic root structures: (1) tap root, and (2) lateral root.

NOTE — Use charts to explain the placement of charges.

COMMENT — On lateral root-type trees, the charge is placed as near to the center of the stump as possible and at a depth at least equal to the radius of the stump base.

On the tap root stump, it is necessary to drill a hole in the tap root and place the charge below ground level. All the charges are tamped with earth in both cases. Are there any questions?

The ditching principle taught here today is only one of several. FM 5-25 and FM 5-34 give more elaborate information on ditching. This particular method was chosen because it will be sufficient to construct the protective moats that you may advise use of during your assignment.

NOTE — Use ditching chart to demonstrate the following:

COMMENT — The ditching method is as follows: Lay off a row of boreholes in line where the center of the moat is desired. The boreholes are 4-feet deep and on 5-foot centers. They are loaded with 40 pounds of primed explosives. The earth is replaced for tamping and the charges are fired.

The resulting ditch will be about 6-feet deep and 20-feet wide. It is recommended that the charges be primed with detonating cord in order to place the blasting caps above ground level. The number of charges that may be fired at one time will depend on the proximity of troops, buildings, etc. Are there any questions?

5H to 5H+ 20 COFFEE BREAK

COMMENT

5H+ 20 to 6H+ 10

Improvised Viet Cong mines: Some materials and methods by which the Viet Cong force improvised land mines is discussed. Explanation of how Viet Cong use a double-boiler to melt and extract explosives from bombs and artillery shells is covered. Procurement of blasting caps is discussed and the imagination of the guerrillas is stressed at all times.

Viet Cong mines: Gentlemen, at this time some of the improvised mines of the Viet Cong will be introduced. The method of procuring blasting caps will be demonstrated. It will be very clear that the Viet Cong is a resourceful soldier who has great imagination.

CONCRETE MINE: A cast concrete mine with a hallow cavity for an explosive filler. The concrete is mixed and poured into a mold. The shrapnel is imbedded in the concrete just before pouring. This mine is made strictly for anti-personnel work. It can be detonated electrically or non-electrically.

AMMUNITION BOX MINE: Ammunition boxes are available wherever combat troops operate. They usually discard them when they are empty. The Viet Cong police up these empty boxes and use them as anti-personnel and anti-vehicular mines. To make an anti-personnel mine, about 2-inches of explosive is placed in the bottom of the box. The rest of the space in the box is filled with shrapnel. The anti-personnel mine can be detonated electrically or non-electrically. To use it in the anti-vehicle role, the box is filled with explosive buried in a road at a selected site and detonated from ambush. To detonate the anti-vehicle mine, the Viet Cong must usually do it electrically; however, it can be detonated by a pull-type firing device.

81-mm MORTAR SHELL CONTAINER: Same as ammunition box mine.

THE USE OF ARTILLERY SHELLS AS MINES: The Viet Cong use captured and stolen 155-mm and 105-mm artillery shells as land mines. They are usually used as anti-vehicle mines and are emplaced in roads and detonated electrically from ambush. To use an artillery shell as a mine, certain modifications must be performed:

1. The fuze of the shell must be removed.

2. The fuze well must be filled with an explosive, or a block of explosive must be put in close proximity to the nose of the shell. An excellent explosive for the purpose of filling the fuze well is C-3 or C-4.

3. The explosive charge is primed electrically and detonated from ambush.

The Viet Cong prefer to use fixed ammunition, that is, ammunition which has the propellent inside a shell case and to which the shell has been permanently fixed, as to separate loading components or semi-fixed ammunition. They use the fuzes, propellents, and the shell casings for other uses such as manufacturing booby traps and mines.

NOTE

Use artillery shell to demonstrate conversion to mine.

COMMENT

SKY HORSE ROCKET: The sky horse rocket is an aimed, direct fire, anti-personnel device. This device is constructed from a cylindrical container closed at one end, i.e., large size pipe, heavy caliber artillery shell case, etc. One end of the container is closed and a hole drilled in for the ignition device. Propellents (match heads, black powder, etc.) is in base of cylinder and a wad is placed in front of the propellent, usually the joint of a piece of bamboo. Amount of propellent depends on the strength of the case and requires a test shot. Next, the shot load, usually rocks, glass, rusty nails, nuts, bolts, or shrapnel picked up from an impact area is placed in the remainder of the cylinder. The open end is sealed with another wad and wax. Bi-pods and sometimes tripods are then added.

In the hole drilled at the rear of the weapon, an ignition device is inserted. This is usually a percussion-type device, activated by a trip wire, but occasionally it will be fired electrically as a command mine. It can also be fired with time fuze.

The ignition device can be a friction type, i.e., match heads and a nail, or the percussion primer from a small arms round and a striker.

This weapon is used on trails and roads. The range is usually about 75-yards.

PROCUREMENT OF EXPLOSIVES AND BLASTING CAPS BY THE VIET CONG: Many of you have wondered where the Viet Cong obtain their explosives and blasting caps; you know that rigid control of these items is being exercised by the government of the Republic of Viet-Nam to keep these explosives out of the hands of the Viet Cong. Explosives are procured in the following ways: (1) By raids and ambushes, (2) stolen from government ammunition dumps, (3) brought down the Ho Chi Minh trail through Laos and Cambodia, and (4) made locally.

1. Raids and ambushes: As you know, the guerrilla never lets arms and ammunition lay on the field of battle. When the Viet Cong ambushes a column of troops or makes a raid on a village or hamlet, they never leave any arms, explosives, or ammunition behind.

2. Stolen from government ammunition dumps: If rigid control and inspection is not enforced upon personnel entering and leaving ammunition dumps, quantities of explosives will find their way out and into the hands of the Viet Cong.

3. Brought down the Ho Chi Minh trail through Laos and Cambodia: After the demarkation line was established, and the northern border of the Republic of Viet Nam closed, the Viet Cong, with the aid of their Pathet Lao counterparts in Laos, built a trail down the length of Laos into Cambodia and into the delta area of south Viet-Nam. Many supplies were brought into Viet-Nam by human labor over this trail.

4. Made locally: Most of the black powder that the Viet Cong use is made by the particular guerrilla band to which they belong. Black powder explosive is not the only thing that the Viet Cong make locally. Blasting caps, when they cannot be procured by any other way, are manufactured by the guerrillas. One blasting cap is manufactured by powdering tetryl, putting it into a small container, placing a flash charge over this, and inserting a fuze and sealing it with wax. Another method is to cut or break the caps from grenade fuzes and use them for blasting caps. To make electrical leads and bridges for electrical caps, the Viet Cont use field telephone wire and a bridge of thin graphite from pencil lead.

EXPEDIENT BOOBY TRAPS: Gentlemen, at this time we are going to introduce you to some of the expedient booby traps that are used in Viet-Nam in order that you may expect, recognize, and, if you are so inclined, advise use of them. Never attempt to disarm expedient devices; destroy in place with a primed charge.

THE SPIKE BOARD: The spike board is by far the most used device of the Viet Cong guerrilla force. This device is constructed from materials that are readily available in any part of the country; these materials being a piece of plank, a handful of large size (16 penny or larger) nails, a hammer, and a file. The nails are driven through the plank and then flattened, sharpened, and barbed. These traps are employed along trails; paddy dikes; in the paddies and fields; at the approaches to villages, hamlets, military camps, and outposts. To make these traps more effective, the Viet Cong will often contaminate it with urine or feces. Many times the Viet Cong will leave an instantaneously fuzed grenade under the board.

MUD GRENADE: The mud grenade is used mostly in the rainy season of the year and always in a location where there is a good chance of someone being present day or night, such as troop billets, radio rooms, etc. It is constructed by molding mud around a hand grenade approximately 1-inch thick up to about 1-inch below the fuze mechanism and allowing it to harden and dry thoroughly in the sun. It is utilized by placing it in the eaves, roof thatching, or other place where it will be exposed to water in quantity. The pin is pulled when the grenade is placed. The water softens the mud and the handle is released, activating the grenade.

NOTE	Device is demonstrated.
COMMENT	GRENADE TRIP: This device is used on trails, in buildings, on roads; in fact, almost anywhere. It is constructed by simply fastening a can or the container that the grenade comes into any object. The trip wire is then tied around the fuze assembly of the grenade (leaving the safety handle clear) and stretched across the trail, road, doorway, etc., and fastened at the other end. The pin is then pulled on the grenade; the can, bamboo, or other container prevents the release of the safety handle. When the wire is triggered, the grenade is pulled from the container releasing the safety handle and activating the grenade.
NOTE	Device is demonstrated on site. Demonstrate use of open loop splice to booby-trap devices and to fire charges.
COMMENT	Most of the devices are excellent means for denying use of an area to the Viet Cong and to booby-trap trails on the withdrawal. They can add a great degree of security when patrols, etc., stop overnight while on the move.
NOTE	Issued charges: Priming, effects, and intended use of the various charges are covered. Use of the charges in the anti-personnel role is emphasized to the class.
COMMENT	ISSUED CHARGES: Now we will discuss some of the standard issued charges of the United States Army. We will discuss their use as anti-personnel weapons. Many of these issued charges are very effective casualty-producing charges when properly employed.
NOTE	Use inert charges to demonstrate.
COMMENT	The first charge we will discuss is the M2A3 shaped charge. This charge weighs 15-pounds of which 11½-pounds is explosive. I would like to call your attention to the class which you received in the bleachers on the Munroe Theory. The Munroe Theory is used in all issued shaped charges to make them effective. The purpose of the shaped charge is to penetrate steel or concrete targets. The M2A3 will penetrate 36-inches of reinforced concrete with the standard fiber stand-off that you see here.
NOTE	As the following is explained, use the actual item and demonstrate the proper method of performing the work.
COMMENT	The shaped charge may be primed in one of several ways: NON-ELECTRICAL METHOD. This method consists of crimping a cap to desired length of time fuze installing a fuze lighter to the fuze in the same manner that you were taught during practical work earlier today. The capped end of the fuze is then inserted in the cap well of the charge. This well is located on top of the charge

at direct rear center, and is threaded to accommodate a priming adaptor. Strings or tape may be used as a substitute for an adaptor.

ELECTRICAL METHOD: To prime this charge electrically, first check the cap with a galvanometer. The cap is inserted into the cap well of the charge and secured. The lead wires of the cap are then spliced into the firing wire and the charge is ready to fire.

DUAL PRIMING METHOD: To dual prime this charge, take a piece of detonating cord and crimp a non-electric blasting cap to one end. Insert the capped end of the detonating cord into the cap well of the charge and secure. Dual prime the other end of the detonating cord electrically or non-electrically and the charge is ready to fire. Are there any questions?

The M-3 shape charge is almost identical to the M2A3 except that it is somewhat larger. The M-3 weighs 40-pounds and contains about 30-pounds of explosive. It will penetrate 60-inches of reinforced concrete. The diameter of the hole made by the M-3 will be about 5-inches. The method of priming the M-3 shaped charge is identical to that used in priming the M2A3 shaped charge.

Both of the shape charges provide any group of soldiers with an excellent anti-personnel weapon. Laid on its side, the M-3 will clear an area of 30-feet by 100-feet of jungle vegetation minus large trees. Filling of the cavity with fragmentation material produces dust of these items rather than throwing the fragments so don't put metal in the cone for an anti-personnel charge. You may place concertina or barbed wire 10 to 12 yards in front of the charge which the hot jet of energy will pick up on its way and throw fragments throughout the area.

We will now fire the M-3 for you to show this jet of energy which moves at 73,000-feet per second. The cone of this shaped charge is made of copper and upon firing, inverts and precedes the jet of energy in the form of a slug.

NOTE — Show M-3 carrot.

COMMENT — We call this slug a "carrot" since its configuration is that of a carrot.

Watch the jet of energy "move-out" straight up.

NOTE — Use GTA and demonstrate method of employing several shaped charges to effect a demolition ambush. Detonate 40-pound shaped charge.

COMMENT — The next issue charge that we will be concerned with is the M-1A2 bangalore torpedo. One section of the bangalore torpedo is 5-feet long and weighs about 13-pounds, and contains a priming well at each end. Ten of these assemblies along with sleeves are shipped in a large box called a kit. The nose sleeve enables the torpedo to be slid over irregular ground quite easily. The primary uses of the bangalore torpedo is to breach barbed wire entanglements and mine fields. This is accomplished by the walls of the container breaking into numerous small fragments when detonated

and cutting the wire. Due to the high velocity of these small pieces, the bangalore torpedo is an excellent anti-personnel weapon. All that is required is a little imagination during employment.

Priming the bangalore is accomplished in the same manner as for the shaped charges with one exception. It may be primed with detonating cord by making at least six turns and tying them around the end directly over the booster. The detonating cord is then primed with electrical or non-electrical caps.

Another issued charge is the 40-pound cratering charge. This charge utilizes ammonium nitrate and TNT for explosives. This prepared charge is contained in a metal case with a cap well and detonating cord tunnel for priming located on the side of the container. A TNT booster is located inside the charge and to the immediate rear of the cap well and detonating cord tunnel. A ring is provided on top for lowering the charge into a bore hole. The demolition card GTA 5-14 and FM 5-25, Explosives and Demolitions, gives the pertinent information on uses of the charge for cratering work.

Priming of the cratering charge may be accomplished electrically or non-electrically. To prime the charge electrically, insert the electrical cap into the cap well. Secure the cap by making at least three turns with the lead wires around the cleat provided for that purpose. The charge is then ready to be emplaced and used. To prime non-electrically, insert the cap into the cap well and secure the time fuze to the cleat with string or tape. When priming with detonating cord, the longest tunnel is used. To accomplish detonating cord priming, pass the detonating cord through the tunnel and tie an overhand knot 6-inches from the end, maintaining the 6-inch pig-tail when finished. The detonating cord is of sufficient length to run from the charge to the surface of the ground. The blasting cap is attached to the detonating cord above ground. This is the most preferred method. If a misfire occurs, a new cap can be attached more easily and with a greater degree of safety. Furthermore, there is no need to dig up the charge to correct the malfunction.

Due to the high rate of misfires among cratering charges, it is recommended that the charge be dual primed by placing an additional primed 1-pound block of explosive on top of the charge.

The ammonium nitrate cratering charge is an excellent casualty-producing device when large pieces of shrapnel are affixed to the outside. Pine knots and railroad spikes are excellent material for this purpose. The tremendous concussion produced by this charge is a bonus effect.

Improvised cratering charge: Ammonium nitrate fertilizer is a material that is readily available in many parts of the world. With AN and one other simple ingredient we have the ability to "tailor make" cratering charges to practically any size or configuration. A rule of thumb for the construction of an improvised cratering charge is as follows; to each 25-pounds of ammonium nitrate fertilizer, which must be prilled or pelleted variety, add approximately 1-quart of diesel fuel, motor oil, or gasoline. The motor oil may be drained from a crankcase, which will not impair the effectiveness of the charge. Allow the charge to soak for 1 hour, prime with 1-pound of TNT, or its equivalent, tamp well in an appropriate borehole, and detonate. The results obtainable with

this charge compare very favorably with the manufactured variety. The prilled ammonium nitrate fertilizer should be of a type having at least 33.3 per cent nitrogen content, and care must be exercised to see that the fertilizer used is not damp. It obviously cannot be left for extended times in a borehole, or water will reduce the effectiveness of the charge. When difficulty is encountered in producing a borehole diameter that is capable of accommodating the bulk of the manufactured 40-pound cratering charge, 8¼ by 17-inches, excellent results can be obtained by pouring and tamping the improvised AN cratering charge into the available space.

The charges discussed here today may be employed in various manners with imagination being the limiting factor. The bangalore torpedo laid in barbed wire entanglements offers excellent reinforcement. Shape charges are handy for blasting through rock when digging wells. Advising others in their use can greatly aid you in your mission.

EXPEDIENT CHARGES: Gentlemen, this is to introduce you to some very effective casualty-producing devices. These devices are similar to devices you will find in Viet-Nam. They are being used by both friendly troops and the Viet Cong. This instruction will demonstrate to you that a trained soldier does not need manufactured items to produce casualties.

NOTE — Use inert training devices to demonstrate the following:

COMMENT — The first device is the grape shot or improvised claymore-type weapon. It is used against personnel and light vehicles. This fragmentation, directional-type weapon may be constructed in various ways, but basically in this fashion. Use any concave shape container such as a bowl or funnel. The container is filled with shrapnel. Next, place the first container inside a second container upside down. A layer of explosive is then placed on the rear of the bowl or funnel. The weight of the shrapnel is divided by four to get the amount of explosive needed. The charge is always primed at the direct rear center. The charge is faced toward the enemy or his expected avenue of approach and detonated when the enemy is within range. This charge may be effective up to 50-yards. Keep in mind the range of this device depends on the construction.

Improvised napalm: When gasoline and non-detergent soap are available, an excellent napalm can be produced. This is done by bringing the gasoline to a boil over a closed flame. The soap is added in a shaved or powdered form until the gasoline reaches the desired consistency. Upon burning, it produces a long lasting hot flame.

NOTE — At this time demonstrate the consistency of improvised napalm and burn a small amount in front of the class.

COMMENT — Soap dish: An excellent charge for both rupturing and igniting the contents of volatile fuel containers. Using a standard GI soap dish, containers up to 100 gallons can be reliably attacked. Charge proportions are as follows: equal parts by volume of plastic explosive and thermate mix are placed in the container to be used, always insuring that the incendiary mix is placed against

the target. The incendiary mix can be composed of a number of compounds among which are three parts of potassium chlorate and two parts of sugar, or two parts aluminum powder to three parts ferric oxide, or ordinary match heads. In lieu of these improvised incendiary mixes, the contents from thermate grenades can be used. As a rule of thumb, a thin cigar box (from 1½-inches to 1¾-inches thick), loaded as specified above with one half C-4 to one half incendiary mix, will reliably rupture and ignite volatile fuel containers of up to 1,000 gallon capacity. A charge of approximately twice that size will successfully attack containers of up to 5,000 gallon capacity. To prime these charges, always insure that the cap is inserted into the C-4, and not the incendiary mix. Holding the charge in place may be accomplished by the use of magnets, tape, or adhesive. Always insure that the charge is placed BELOW the fuel level in the container.

NOTE — Fire soap dish against 55 gallon drum of diesel oil.

6H+ 10 to 6H+ 50 — Walk through demonstration area and return class back to bleachers.

During walk through the below-listed charges will be explained and shown to the students.

The charges will be emplaced for employment against targets.

1. Bangalore torpedo.
2. Grape shot.
3. W. P. ambush.
4. Timber charge.
5. 3.5'' rockets.
6. Detonating cord in ditch.
7. Cratering charge.
8. Demolition ambush.

6H+ 50 to 7H+ 10 — At this time a 20-question spot quiz is conducted. The quiz will be handed in to the OIC.

NOTE — Fire demonstration charges.

7H+ 10 to 7H+ 40

NOTE

7H+ 40 to 8H — CLOSING: In closing, emphasize that demolitions can play a major role in this simple war in Viet-Nam or anywhere in the world and that explosives can be of great aid in civic action work also. Summarize main topics and pass out summaries, then release class to inspect targets and depart the demolition range.

UNITED STATES ARMY SPECIAL WARFARE SCHOOL

CALCULATION AND PLACEMENT OF CHARGES

LESSON PLAN

1. CONCEPT: This subject is designed to give the student a working knowledge of the procedures involved in calculating and emplacing explosive charges to accomplish a wide variety of demolition tasks. Emphasis is placed on the techniques of problem solving, as opposed to extensive exercises in the mathematics of calculation. This subject includes the following:

a. Gaining an appreciation of the need for accurate calculation and placement of charges, and the dangers of estimation.

b. Formulas for steel cutting, timber cutting, pressure charge calculation, road cratering and abutment destruction, and the calculation of breaching charges. Placement of each of the foregoing charges is also discussed.

c. Target reconnaissance and reporting procedures.

2. COURSE SCHEDULE:

a. This subject is presented to the Special Forces Officer Course. The instructor must be familiar with subject U3.T7508, Introduction to Demolitions.

b. In the homework assignment, the student will study selected paragraphs from FM 5-25, Explosives and Demolitions, that deal with each of the general subjects mentioned in paragraph 1b, above. He solves the first requirement.

c. Suggested time schedule:

H to H+ 10	Introduction to the subject of calculation and placement of charges, and the dangers of estimation.
H+ 10 to H+ 25	Familiarize the student with the rounding-off-rule and with procedures for using the Demo Card, GTA 5-14.
H+ 25 to H+ 50	Acquaint the student with the three types of steel and the two types of steel cutting formulas. Rule of thumb for rail cutting, placement of charges for shearing, and devices for securing charges to steel targets.
H+ 50 to 1H	BREAK
1H to 1H+ 25	Acquaint the student with timber cutting formulas, both external and internal, and with placement of charges to control the direction of fall when cutting trees.
1H+ 25 to 1H+ 40	Acquaint the student with the techniques of road cratering, both hasty and deliberate.
1H+ 40 to 2H	BREAK
2H to 2H+ 20	Acquaint the student with the knowledge of calculating and emplacing pressure charges.
2H+ 20 to 2H+ 50	Acquaint the student with formulas and placement techniques for emplacing breaching charges, using conventional breaching techniques.
2H+ 50 to 3H	BREAK

3H to 3H+ 10	Acquaint the student with ERDL "Square Charge," for breaching reinforced concrete.
3H+ 10 to 3H+ 20	Acquaint the student with advanced tamping concepts and the bubble charge.
3H+ 20 to 3H+ 25	Acquaint the student with the advantages and limitations of advanced techniques.
3H+ 25 to 3H+ 45	Familiarize the student with the use of the target reconnaissance report guide, and the problems of target reconnaissance.
3H+ 45 to 3H+ 50	Summary is issued and discussed with the class.

d. Issue Plan

(1) Prior to class: Advance sheet with Target Reconnaissance Report Guide and GTA 5-14, Demolition Card. Section I, 1st Requirement.

(2) During class: Section II, Summary.

e. Conduct of Lesson

(1) Prior to class:

(a) Instructor. Develop a thorough understanding of the broad field of demolitions, and concentrate on each of the formulas and techniques to be covered during this specific subject.

(b) Student. Develop a working knowledge of the subject material by studying the homework assignment.

(2) During class:

(a) First hour: Instructor lectures on the requirement for accurate calculation and placement and the dangers of estimation, the rounding-off rule and the use of the Demo Card, and on the types of steel and steel cutting formulas. Students work sample steel cutting problems.

(b) Second hour: Instructor lectures on timber cutting formulas and their placement. Students work timber cutting problems. Instructor lectures on hasty and deliberate road cratering techniques.

(c) Third hour: Instructor lectures on calculating and emplacing pressure charges and breaching charges. Students work problems in the calculation of breaching charges.

(d) Fourth hour: Instructor lectures on ERDL square charge, advanced tamping concepts, the bubble charge, advantages and limitations of advanced techniques, and target reconnaissance procedures. Summary is issued and instructor answers questions.

UNITED STATES ARMY SPECIAL WARFARE SCHOOL
CALCULATION AND PLACEMENT OF CHARGES

COMMENT

H to H+ 10

Good morning, gentlemen. This morning we have a 4-hour unit on, as you can see, Calculation and Placement. I am quite familiar with the general feeling of letdown that is experienced when demolitions is brought from the range into the classroom, and I'll admit that it's understandable. I think most of us like the big bang associated with demo work, but we have in reality no more than just scratched the surface of demolitions when we have just learned how to construct and detonate the various charges. The real meat of the subject lies in knowing how to use your demo like a surgeon's scalpel, so that you can skillfully dismember a target.

Let's consider the two key words in our subject title. For all practical purposes they are inseparable. You must know WHERE a charge is to be put before you can calculate the amount of explosive to be used. The objective of this instruction is to familiarize you with the principles that govern calculation and placement. In this regard, let's consider what we will and will not do during our class.

We WILL be concerned with the principles of cutting, breaching, cratering or destroying certain types of targets. We will NOT become involved in detailed problem solving or long exercises in basic mathematics. We will work a few problems using various formulas, but our reason for working them will be to gain an understanding of the formulas. The subject of calculation and placement is not an exact science; rather, it is a guide for our demo work, an effective starting point. In this subject, as in many others in Army schools, there will often be more than one solution to a given problem.

The importance of knowing WHERE to place charges on a target can hardly be over-emphasized.

NOTE

Draw sketch of stepped steel shaft.

COMMENT

It is a fairly simple matter to teach an individual how to cut steel; this is no great problem at all. But teaching this individual how to effectively cut the key members of a steel bridge so that a specific desired result is obtained, is quite another matter. And yet if we were only going to have to operate against one kind of steel bridge, the problem would still be relatively simple. But when we consider the many different types of bridges, the different materials used in bridge construction, and the fact that bridges are just one type of target out of dozens, the problem of learning how to inflict a desired level of destruction on all of these targets becomes a complex and demanding one. This knowledge is not gained in a few hours, or days, OR weeks.

NOTE

Show Chart 1

COMMENT

Your demo man in most cases will probably have the necessary knowledge to effectively attack and destroy a given target. YOUR responsibility is to plan, study, and gather information about the target systems in your operational area. If you are charged with interdicting highways and have decided to concentrate on bridges, YOU will have to decide which bridges to attack; your demo man will help plan HOW best to attack them. He is like a fine weapon, just point him in the right direction and he'll get the job done, but the responsibility for pointing him in YOURS.

This morning's instruction will be broken down into the following distinct subjects: steel cutting, timber cutting, cratering, pressure charges, breaching, and some few advanced techniques. Before we proceed, it is necessary that we discuss and understand tamping.

NOTE

ON VGT 1 Shows effect of tamping.

COMMENT

Unless you have recently been exposed to demolitions instruction, you may think you understand the factors affecting tamping, but some of the old concepts have recently been proved to be in error. Earlier, we taught, for instance, that a charge placed against a bridge pier underwater benefitted from the tamping effect of the water. This is not true. Also, except for shaped charges, we taught that almost every charge would be made more effective by the addition of tamping. Several of our advanced technique charges gain nothing by being tamped; this will be pointed out as we discuss these charges.

Another development is the importance attached to the placement of the cap in a charge. Formerly, only in priming detonating cord did we pay close attention to the direction the cap pointed. Now this is a critical factor in the construction of many of our advanced charges. Before we proceed, are there any questions at this point?

A poor alternative to the "calculation and placement" approach to demo work is estimating the amount of explosive needed. An experienced demo man's estimate may often be quite accurate, but the system is always open to error. Any mistake involving demolitions in a combat situation may have serious consequences for a number of reasons. OVERESTIMATING the amount of explosive results in the waste of both the explosive and the effort required to transport it, neither of which can we afford to waste. Remember that the explosives will almost always have to be manpacked. Also, it may result in the concentration of too large a group of people in the target area, with its attendant possibilities of disaster. UNDER-estimating results in the failure of the demo task, and, quite often, the failure of that entire mission. A second chance is a luxury seldom afforded a guerrilla force. Of the two

evils, overestimating is much better than underestimating, but with a proper knowledge of calculation and placement, we can avoid both of them. Improper placement, of course, is equally as bad as improper calculation, which brings us back to the concept stated earlier, that the two words in our title are equally important.

NOTE

ON VGT 2 Rounding-off Rule

COMMENT

H+ 10 to H+ 25

The rounding-off rule shown here is an inexact rule that requires two things of its user. One is a knowledge of how the explosives are packaged, and the second element is simply common sense. If the answer to a problem worked with a formula is, for instance, a shade over 2½- pounds of C4, the rule states that the next higher packaged unit be used. A better solution, and certainly a more sensible one, would be to use one-fourth or one-eighth of the second block, thereby insuring that the job will be done, but the explosive will not be wasted.

At this time take out your Demolition Card, GTA 5-14. This card is a fine ready reference for the demolitionist, and properly used in the field can be a great time saver. It contains much of the information that we need in demolitions work, and as you will note, it has been treated to be moisture resistant. Its sides have been numbered from 1 through 6. Let us begin by examining the information contained on side 1. Remember that I made a point of stating that TNT is our "standard" explosive, and that the effectiveness of the others is measured against it. In the "relative effectiveness" chart we see that TNT is rated as having an effectiveness of 1.00. C-4, which some of you may remember has a detonating velocity of 26,000-feet per second (as against 21,000 fps for TNT), is more powerful than TNT, and thus requires less explosive to accomplish the same task. Its value is 1.34, and we DIVIDE the POUNDS of TNT required by 1.34 to determine the amount of C-4 (or C-3 or C-5) that would be required. It is important to read the note below the chart, and see that ALL formulas on the chart yield an answer in POUNDS OF TNT. Next we see the penetration figures for shaped charges against reinformced concrete and armor plate. An immediately below that chart are listed some often-used rules of thumb and conversion factors for all tables. At the very bottom of the card take note of a valuable aid, a ruler scaled to inches on this side and centimeters on the other.

A the top of side 2 we see the chart for calculating pressure charges; note that at the top of the chart is the pressure charge formula. Along about here the question often arises, "with this card having all this information, why should a demolitionist bother to learn the formulas?" There are several answers. One, he may just not have the card, for a variety of reasons. Two, working the formulas gives him a feeling for the amounts of explosive required and a knowledge of his subject that simply reading ready-made answers will never do. And third, the charts only go so far, and to compute the pressure charge, for instance, of a beam that is

higher than 5-feet and thicker than 3-feet, the formula will have to be used. The bottom portion of side 2 contains timber cutting data. Remember, all you have to do is take the measurements and get the necessary dimensions, and then read the answer in pounds of TNT directly off these charts.

Side 3 contains steel cutting information. It gives formulas and an example problem at the top, and instructions telling how to use the table at the bottom. The table is used much the same as the one discussed on side 2, and you'll note that the rounding-off rule is brought into play on almost every answer.

Side 4 has breaching charges for reinforced concrete, side 5, breaching charges for masonry items other than reinforced concrete, and side 6 has cratering and bridge abutment information. Sides 4, 5, and 6 appear at first glance to be complicated, but on closer inspection and by READING THE PROBLEM they are found to be, in reality, quite simple. We will refer to the cards again from time to time this morning, but for now please put them aside.

COMMENT
H+ 25 to H+ 50

For the remainder of this period we will discuss steel cutting, using standard techniques. It should be quite obvious that targets made of steel will often be primary objectives in guerrilla operations. At this point I would like to remind you of the desirability of tamping steel cutting charges, among others, to obtain maximum effect of the explosive. And yet we should remember that quite often our time in the target area will be so limited that tamping will be precluded. Thus our answers using steel cutting formulas are all for untamped charges.

Let's examine the three general classifications of steel, and see how they affect our formulas.

NOTE

ON VGT 3 Grade of Steel --1) Structural Steel; 2) Steel Alloys; 3) High Carbon Steel)

COMMENT

Structural steel or mild steel is the grade of steel which we will most frequently encounter, because it is the material from which buildings, bridges, and most steel structures are built. High carbon steel and the alloys, all being extremely hard, are grouped together for the purpose of our steel cutting formulas.

NOTE

OFF VGT 3

COMMENT

The standard formula for cutting structural steel is: $P = \frac{3}{8} A$. "P," remember, equals pound of TNT required, while "A" equals the cross sectional area, in square inches, of the member to be cut.

NOTE

ON VGT 4 Steel Cutting Formula

COMMENT

To determine the cross-sectional area in square inches of a steel member, break it down into rectangular sections; multiply the length of each section by its width, and add the sums together.

NOTE — OFF VGT 4

ON VGT 5 Problem on example steel "I" beam

COMMENT — Discuss answer to problem.

NOTE — OFF VGT 5

COMMENT — The answer to this problem is 21-pounds of TNT; does everyone understand how we arrived at this answer? Now let's carry this problem one step further, and determine how many POUNDS of C-3 and also how many pounds of military dynamite would be required to cut this same member. Refer to your table of relative effectiveness on page 1 of the demo card.

NOTE — Class take time to work both of these simple problems. Call on a different individual for each answer. (Instructor's note: C-3 requires 15.75-pounds, or seven blocks; military dynamite requires 23-pounds.)

COMMENT — Now using this same formula, compute the number of blocks of tetrytol required to cut this structural "T" girder, using an untamped external charge.

NOTE — ON VGT 6 (Instructor's note: Call on student for solution. Answer is 25-pounds of tetrytol, or 10 blocks.)

OFF VGT 6

COMMENT — For cutting steel where close contact between the explosive and the target is difficult, due to its small size or irregular shape, we use the formula $P = D^2$.

NOTE — ON VGT 7

COMMENT — You will note that to cut this chain we need two 1-pound charges, one to be placed here at point A, and the other opposite it at B. If you will glance at page 3 of your demo card again, you will see that this formula holds true for chains, rods, cables, and bars ONLY UP TO A DIAMETER OF 2 INCHES. Above this diameter we can revert to $P = \frac{3}{8} A$.

NOTE — OFF VGT 7

COMMENT — Obviously, a very common target for us will be railroad rails, and we have a simple rule of thumb for computing charges necessary to simply cut the rails.

NOTE ON VGT 8

COMMENT Refer to rules of thumb on side 1 of demo card. While it is true that 1-pound of TNT will cut rails larger than 80-pounds, it is also true that a simple cut is easily repaired. For this reason we carefully select locations where our charge will inflict maximum damage such as those on this slide.

NOTE OFF VGT 8

ON VGT 9

OFF VGT 9

COMMENT As we conclude this discussion of steel cutting, let's consider the proper methods of placing charges against the targets.

NOTE ON VGT 10

COMMENT To achieve maximum effect, close contact with the target is required. When cutting irregular shapes or thicknesses, more explosive should be placed against the thicker portions. Holding charges in place effectively poses a very real problem for the demolitionist.

NOTE OFF VGT 10

COMMENT One of the best devices we have for this purpose is the rivet-punching, powder-actuated driver; but don't expect many of these to be available for use by a guerrilla force. This slide shows some expedient methods of securing a charge to its target.

NOTE ON VGT 11

COMMENT Individual ingenuity will be required to solve this problem under combat conditions.

NOTE OFF VGT 11

COMMENT Are there any questions regarding anything we have covered to date?

H - 50 to 1H BREAK

COMMENT

1H to 1H + 25

We will begin this hour with a discussion of cutting timber by the use of explosives. As one student, who must have been a forest ranger in civilian life, once pointed out, using explosives to cut trees is a terrible waste of wood. But while his statement is undeniably true, he missed the point of our problem--we're in the DEstruction business, not CONstruction. Let's think of a few

of the reasons we have for wanting to cut wood. We may want to destroy bridges or other structures built of wood; we may want to fell trees across a road and create an abatis; or we may want to cut trees quickly for the purpose of creating a DZ; or, to get back to our frustrated forest ranger's hypothesis, we might conceivably even want to fell trees quickly to use them in constructing fortifications.

One thing we should do before deciding to use demolitions for timber cutting is to be sure that this is the best way of getting the job done. For instance, if our target is a wooden bridge, if time permits and materials are available and the weather is favorable, then fire would undoubtedly do the most complete job of destruction. Some frivolous types in past classes have even mentioned using termites.

The formulas for cutting timber with explosive charges are designed to cut most woods; but tropical hardwoods and such fibrous woods as conconut will require experimentation to determine correct charges. Please refer to the timber cutting charges on page 2 of your demo cards. Those of you who have had contact with demolitions before will at once recognize the two formulas shown here. The external cutting method uses the formula:

$$\frac{P = D^2.}{40}$$

Since we will seldom have either the time or equipment to bore a hole in wood so that we can use an internal charge, this formula is the one we will most often use. "P" in this formula, remember equals pounds of TNT; while "D" is the LEAST DIMENSION in inches. (Give demonstration of breaking a board, and show how common sense dictates that we break it at its thinnest point.)

Work the problem shown here and be prepared to present your answer to the class.

NOTE

ON VGT 12 (Call on a student for his answer, and insure that everyone understands it before proceeding.)

OFF VGT 12

COMMENT

A knowledge of placement of charges is important in timber cutting as it is in the rest of our demo work. When you desire to completely sever the timber (and there may be times when you will not), the explosive must completely encircle the target. Dividing and packaging the explosive to permit such encirclement can be a time consuming chore; and as with most of our combat charges, effort should be made to prepare them ahead of time. When cutting trees to form an obstacle, the explosive should be concentrated as much as possible on one side of the tree--this, together with the proper formula, will leave the felled tree attached to its stump.

There may be times when we will want to control the direction of fall of a tree, such as to create a temporary roadblock as a part of a vehicular ambush. Any one or all three of the following factors will affect the direction of fall: The location of the charge on the tree (it will fall TOWARDS the side where the charge is); the natural lean of the tree; and the wind. Only considerable experience, and perhaps even a degree of luck, will enable a demolitionist to consistently fell trees in a predetermined direction. Small kicker charges placed well up on the tree may also push it in the desired direction.

Another very effective way to cut timber is by using an internal charge. The internal formula is:

$$\frac{P = D^2.}{250}$$

While I don't intend to work any problems using this formula, there are some important things to know about placement of the charge. The hole is bored approximately two-thirds of the way through the target, and the charge is placed as close as possible to the exact center. If the charge is too large to effectively go in one borehole, bore the second as close as possible to the first, and prime the charges for simultaneous detonation. If the target is other than round or square, i.e., a long oval or a rectangle, the hole should be bored parallel to the long axis. All internal charges must be tightly tamped if maximum effect is to be realized. If we have the time and equipment, the use of internal charges permits great savings in explosives. One last point, although we would seldom use an internal charge operationally, it does possess one advantage which might lead to its use; once in place, it can be so effectively concealed that only a careful search would reveal it.

We have now covered the two formulas on your demo card, but there are a few more that you should know about. One is the formula for felling trees to create an obstacle, when we want the tree down BUT NOT SEVERED FROM THE STUMP. The formula is:

$$\frac{P = D^2.}{50}$$

"P" in this formula yields an answer in pounds of TNT, and is calculated to give us the amount of explosive to use in a test shot. We should remember that different test shots will be required for varying types of wood; in other words this formula may work without further adjustment on most oak trees in a given stand, but it may be too heavy for elm in the same area. It should be noted that this information is contained in C-1 to FM 5-25, and the information given on page 119 is in error and has been superseded by the change. Work this simple problem and be prepared to present your answer to the class.

NOTE

ON VGT 13 (Discuss answer, insuring everyone understands it.)

OFF VGT 13

COMMENT

Here is one more relatively new external formula, and a very convenient one. It is P=C. "P" in this case is C-4, and "C" is the circumference of the target in FEET. This formula holds true for trees up to 5¼ -feet in circumference. Although this formula is one that has been superceded by change 1 of the manual, it is, nevertheless, a workable one. As a point of interest, this formula has been used by special forces demolitionists in Laos with a fair amount of success. They used a cord, knotted at 1-foot intervals, for the measuring device when faced with the task of teaching illiterate indigenous troops how to cut trees. C-4 was present in the country in quantity, and with very simple instructions on how to compute the number of blocks of C-4 from the number of knots in the cord, our people were able to get their point across easily. As I mentioned a minute ago, this particular formula HAS been superseded, but it DOES work. I mention it primarily to illustrate how the teaching problem can be solved in spite of literacy and language problems.

One point worth remembering in connection with timber cutting formulas is that they are a guide or a starting point if you ever become involved in large scale timber cutting operations. By conducting some careful experiments at the beginning of the operation, and adjusting the explosives so that just the right amount is used, you will probably be able to effect considerable savings. Are there any questions at this time?

Before we leave our discussion of timber cutting completely, there is one more important point that the manual makes regarding the placement of timber cutting charges, and it is an important one to remember in all of our work with C-4. In Change 1, paragraph 119a, it states, "The C-4 should be cut carefully so that kneading will not be necessary. If the explosive is rolled or worked with the hands, it will become soft. The soft explosive is considerably less effective than the pressed explosive block." I will refer back to this concept when we discuss our advanced techniques. Remember that the density of the explosive is directly related to its effectiveness.

COMMENT

1H+ 25 to

1H+ 40

The remainder of this hour will be devoted to a brief discussion of cratering. Road craters, to be effective obstacles, must be too wide to be spanned by track laying vehicles and too deep and too steep-sided for vehicles to pass through them. Guerrillas may not elect to engage in cratering operations very often, but when they do find it necessary, the crater must be an effective one. In other words, any obstacle is made more effective if it is covered by fire, and guerrillas may well not be able to remain on the scene and provide such cover.

Refer again to your demo cards, page 6. You will see that there are two types of craters listed; the deliberate road crater and the hasty method. Keep in mind that either cratering method entails the expenditure of considerable time, effort, and explosive. The main difference between the two types of craters lies first in the amount of work involved; the hasty method being quicker and easier to put in. But the hasty crater is not as effective an obstacle as the deliberate.

Breaching concrete or other hard surface roadway may often be a problem that must be solved before your boreholes can be sunk. Whether this is done with demo or with tools, in either case it doesn't add up to a silent clandestine type of operation.

NOTE — ON VGT 14 (Charges for Road Cratering)

COMMENT — This cross-sectional view of a road with charges emplaced to create a deliberate crater is similar to the one in your demo card. Holes are bored 5-feet apart, center-to-center, in line; end holes are 7-feet deep, and the others alternating 5 and 7-feet deep. Use ammonium nitrate 40-pound cratering charge; two charges in the 7-foot holes, one in the 5-foot holes. Note that here we came out with an even number, and the rule of thumb is to make the center holes the 7-foot, 80-pound charge variety. All charges are primed for simultaneous detonation, are well tamped, and are dual primed.

NOTE — OFF VGT 14

ON VGT 15

COMMENT — Here we see the hasty crater charge set-up. All holes are of equal depth, from 2½ to 5-feet. Again they are 5-feet apart, and be sure to start at the shoulder of the road. Ten pounds of explosive per foot of depth of the boreholes. Crater should be 1½ times deeper and 5 times wider than the depth of the boreholes, and about 16-feet longer than the line of boreholes. The sides have a slope of 30 to 60 degrees, depending on the type of soil. And speaking of soil types, remember that an effective crater cannot be blown in loose sand.

NOTE — OFF VGT 15

COMMENT — Before dismissing the problems of road cratering, we should remember that before we can dig boreholes, it may often be necessary to first break through a hard surface pavement. As you discovered in the course of solving the homework requirement prior to class, there is a technique for this type of breaching that amounts to a rule of thumb. Simply stated, it requires 1-pound of TNT for each 2-inches of pavement, covered by twice as much (or in this instance, 4-inches) tamping. This of course is anything but a clandestine way to breach the pavement; with it you sacrifice silence but gain speed. Are there any questions at this time?

1H+ 40 to 2H — BREAK

COMMENT

2H to 2H+ 20

This hour, gentlemen, is designed to familiarize you with the formulas and principles employed in the use of pressure and breaching charges. We will begin with pressure charges, because I want to follow our discussion of breaching charges with information on an advanced breaching technique. It is necessary to pay careful attention to the nomenclature of these two completely different charges.

Pressure charges are used against simple span, reinforced concrete, T-beam bridges. So a pressure charge has its place in the relatively narrow field of bridge destruction, and we'll be referring to this technique again in our bridge demo class. The effect of exploding pressure charges is to partially breach and overload the span; this causes the bridge to break in mid-span and pull free from the abutments or piers. The formula we use to compute the pressure charge is: $P = 3H^2 T$. P equals pounds of TNT for EACH beam, all charges tamped. H is the height of the beam in FEET, and T is the thickness of the beam in feet. Using the dimensions given on this slide, and referring to side 2 of your demo card, what size charge (using TNT) will be required?

NOTE

ON VGT 16

COMMENT

Be prepared to present your answer to the class.

NOTE

Discuss answer thoroughly.

OFF VGT 16

COMMENT

Now put your demo cards aside for a moment, and look at this next problem.

NOTE

ON VGT 17

COMMENT

You will note that in this problem the center T-beam is smaller than the outside beams, so you will have to compute two different sized charges. Work the problem using the formula, and be prepared to present your answer. Now you'll notice in our answer that the total charge to overload and break one span is 360-pounds; and to be really effective, we would usually want to cut two spans. The total for two is 720-pounds, which I think is a very significant figure. Too often we tend to overlook the massive amounts of explosive and other material (remember all of these charges must be tamped) that are needed to accomplish relatively simple demo tasks. And even if we break two spans on this bridge, we have only inflicted temporary damage that would pose no great challenge to a good engineer unit. To completely demolish this bridge and make its rebuilding a major problem, we would have to destroy its abutments, footing, dam, and intermediate supports. Depending on the size, shape, and composition of these components, the amount of explosive required could easily reach the neighborhood of two tons. Of course, a guerrilla force will seldom be

concerned with COMPLETE destruction of a target, which is fortunate because they would seldom be able to carry it out.

NOTE — OFF VGT 17

COMMENT — This formula is not effective for use against continuous span concrete bridges because the ends of the spans are not free to pull loose at the piers or abutments when the center of the span is broken.

NOTE — ON VGT 18

COMMENT — This slide is interesting because it illustrates a mistake, a glaring error. Can anyone spot it? The answer is that the charges are emplaced near the pier, and not at midspan. All of the work that went into calculating and preparing these charges would probably be wasted, or at least maximum destruction would not be realized. Are there any questions on pressure charges before we proceed?

NOTE — OFF VGT 18

COMMENT
2H+ 20 to
2H+ 50

The remainder of this hour will be devoted to a discussion of breaching charges. The most important use of breaching charges is in the destruction of bridge piers, bridge abutments, and field fortifications. They may also be used to breach walls and to blow holes in concrete slabs and roadways. Breaching charges provide us with possibly our most complicated formula, and the reason this subject gets complicated is because of the many variables. The thickness of the target to be breached is one variable, the material from which the target is made is another, and the tamping factor, which depends on the location and tamping of the charge, is another. The formula for calculating breaching charges is: $P = R^3KC$. P equals pounds of TNT required. R is the breaching radius in feet. K is a material factor, which reflects the strength and hardness of the material to be demolished. C is the tamping factor, which, as I already mentioned, depends on the location and tamping of the charge. This is one formula that obviously will NOT need to be memorized by the demolitionist, because it can only be used in conjunction with tables of values for K and C.

We will examine the problem of breaching by first considering the conventional, and possibly most complicated, approach. Turn to page 127 of FM 5-25. As an indication of the importance of reading the fine print, notice the note midway down the page. Now direct your attention to Table X, and notice how the values of material factor, K, change from ordinary earth up to reinforced concrete. Now turn the page and examine figure 83, which gives the values of C. There is some valuable information contained in that chart; note for instance the disparity between the value of the tamped internal charge, 1.0, and that for an untamped charge placed at ground level, 4.5. For our purposes, in a combat situation, we would ALWAYS consider K to be reinforced concrete if we were unsure of its exact composition.

Now let's look at sides 4 and 5 of our demo cards to see how it has helped simplify calculation of breaching charges. Note that the chart on side 4 is for reinforced concrete only, but that all we have to do is measure our target, determine how the charge is going to be emplaced, and read the amount of TNT directly off the chart. For instance, what amount of TNT will be required to breach a wall $3\frac{1}{2}$-feet thick, using an untamped charge halfway up the wall?

The answer is 83-pounds of explosive. Now to better gain an appreciation of the amounts of explosive required for this task, look at the amount needed to breach an 8-foot thick wall with an untamped charge at ground level. Nine hundred and ninety-one pounds is certainly a large amount, and by simply moving the charge up 8-feet off the ground, we can cut that figure to 771-pounds. But think of the problem of securing 771-pounds of explosive against the target 8-feet off the ground.

Now look at the table of conversion factors for material other than reinforced concrete on side 5 of the demo card. Now let's read together each of the five steps for using this table. As you can see, the demo card has greatly simplified our task when we are faced with a breaching operation. Now put the card aside again for a moment, and let's work this one simple breaching problem.

NOTE ON VGT 18

COMMENT Use Table X in the manual to determine the value of K, and Figure 83 for the value of C. Be prepared to present your answer to class. The really important point to remember in connection with breaching by conventional methods is the large amounts of explosive required.

NOTE Fully discuss answer.

OFF VGT 18

COMMENT At this time we will consider one of our advanced techniques that offers great savings in demolitions. Now remembering that we needed 124-pounds of TNT (which converts to 94-pounds of C-4) to breach the 4-foot wall in the problem just worked, here is a method that will drastically reduce that figure. First though, let's consider the amount required if we would employ an internal charge in this reinforced concrete wall; glancing at the demo card we see that it is only 8-pounds of TNT but the problem of placing the charge internally shouldn't need any elaboration.

Discuss the opposed charge principle, rule of thumb, and amount necessary to destroy this same 4-foot target. Multiply target thickness in feet by 2, which gives the number of pounds of PLASTIC explosive required. Round off fractions of feet to the next higher foot. Divide total amount of explosive required in half and construct two identical charges. Place diametrically opposite

each other (a problem in having both sides of the target accessible), and prime each charge from exact center rear, and insure simultaneous detonation of both charges. So you can see that we will use only 8-pounds of plastic explosive (not TNT), and while we have to take some pains in the placement of the charges, we achieve the same effect with, relatively speaking, the same small amount of explosive. During the next hour we will examine another advanced technique. Are there any questions?

2H+ 50 to 3H — BREAK

COMMENT

3H to 3H+ 10

Now we have seen during the past hour how it would require 124-pounds of explosive to breach a 4-foot thick wall of reinforced concrete. And we then discussed a technique whereby the charge could be reduced all the way down to 8-pounds. At this time I want to acquaint you with still another breaching technique. While it does not offer savings as dramatic as those given by the opposed charge, it does offer great savings over the conventional technique. In addition, this new technique is quicker and simpler to emplace than the ear muff, requiring access to only one face of the target. And there is one drawback that I have not previously mentioned, regarding the use of the opposed charge, which is that it has only been proven effective against targets up to 4-feet thick.

The following breaching technique was developed by the Engineer Research and Development Laboratories at Fort Belvoir, Virginia, as a result of tests conducted in 1958, 1959, and 1960. The technique has no convenient title, but it is referred to as "Hasty demolition of concrete structures" in the ERDL study. We will call it the ERDL square charge.

NOTE — ON VGT 20

COMMENT

While no formula that is usable by troops has been evolved, this table shows the amount of plastic explosive required for breaching walls from 1 through 8 feet thick. A brief explanation will acquaint you with some of the most important principles governing the employment of these charges.

First, the C-4 should be placed a distance equal to the thickness of the target above its base to be most effective (in the study, charges placed at the base of a slab produced craters 23 per cent smaller than those placed above the ground). So we are still faced with the problem of holding our charges in place. If you will notice the amount of C-4 called for on the chart to breach our 4-foot wall, you'll see that it is 20 blocks, or 50-pounds, which is an appreciable saving over the 124-pound figure (or 94-pounds of C-4) we discussed awhile ago. To return to the principles of employment, a square charge yields best results. Best effects are gained from rear center priming, or initiation. Tamping does not increase the effectiveness of these charges. Close contact with the target is required, and charge thickness indicated on the chart must not be deviated from. Are there any questions on this breaching technique before we proceed?

NOTE — OFF VGT 20

COMMENT
3H+ 10 to 3H+ 20

Before we continue the discussion, this seems an appropriate time to briefly discuss an advanced tamping concept.

NOTE — ON VGT 21

COMMENT

At the top of this slide you will notice a charge tamped using the conventional method, with tamping material surrounding the charge. And here at the bottom we have the advanced concept. Note that the charge is primed on the side away from the target, with the cap directed through the body of the explosive towards the target. The tamping material is wet sandbags, or we'll assume it is if it is to be effective. Note that the shock waves travel diagonally out and down through the tamping and into the target. Thus in the advanced concept we're not trying to confine the force of the blast; we are channeling it into the target.

NOTE — OFF VGT 21

COMMENT

Some members of the class may have been somewhat startled back during the first hour when I made a statement regarding underwater charges and tamping. Specifically, what I said was this: That a charge placed against a bridge pier underwater does not benefit from the tamping effect of the water. This statement is in direct contradiction of demolition concepts taught only 4 or 5 years ago. When the Engineer Research and Development Laboratory employed a large staff of scientists to investigate all phases of demolitions activity, this group began, appropriately enough, by taking nothing for granted. They agreed that water is certainly a fine tamping agent, under the correct circumstances, but that it does not ALWAYS increase the effectiveness of explosives. Let me show you by means of this simple sketch how water may hinder rather than help an underwater charge.

NOTE — Draw simple sketch of pier underwater, with a charge in place.

COMMENT

While it is true that the water pressure is pushing against this charge at "X" pounds of pressure per square inch, it is also true that it is pushing in on the entire circumference of the pier at the same pressure. Water has an absorbing or muffling effect on an explosion, so that when the charge detonates, the water absorbs the effect of the blast at the same time that it helps actually to compress or strengthen the pier. In contrast to this effect, we have the following example.

NOTE

Draw simple sketch of a side view of a dam, with a high water level on one side only, and a charge placed behind the dam, on the water side.

COMMENT

In this case the charge WILL receive full tamping benefit from the water, and the weight of the water will undoubtedly cause damage far out of proportion to that which would normally be expected from a similar charge on a similar type target where the tamping material was changed to earth.

NOTE

ON VGT 22

COMMENT

The technique illustrated here is one whereby somewhat the same effect as that found in the charge behind the dam can be created artificially. We begin with a target that is completely surrounded with water. On one side we place a much smaller charge, perhaps only some 3 to 5-pounds. This smaller charge is primed with a length of detonating cord that runs up above the surface. (This is the easy way to prime underwater charges, and it solves many problems of waterproofing electrical circuits.) The electrical cap attached to the main charge is of the delay variety; that is, it is a 1/32 of a second delay cap. Both caps receive their electrical charge at the same instant. The smaller, or bubble charge, naturally detonates first, and by the very nature of the explosion, a rapidly expanding cloud of gas is formed. One-thirty-second of a second later the main charge detonates, and it is able to exert force through the pier into the free air or bubble created opposite. This technique can be expanded to incorporate several "bubble charges," and as with many advanced techniques it has the advantage of saving explosive and the disadvantage of requiring more time and effort to emplace.

NOTE

OFF VGT 22

COMMENT

3H+ 20 to
3H+ 25

Before anyone is misguided into thinking that the various advanced charges have rendered conventional demolition formulas and techniques obsolete, consider some limiting factors. Most advanced techniques rely on the use of plastic explosive, which conceivably might not be available in an operational area. Also, many of these charges require considerable time and effort to prepare, certainly a limiting factor if too much time in the target area leads to loss of life. One final point that deserves mention: we are not going to be able to mold or work plastic explosives under arctic conditions. But when conditions are favorable for their use, the advanced techniques are efficient, economical, and highly satisfactory.

COMMENT

3H+ 25 to
3H+ 45

At this time I would like you to take out your target reconnaissance report guides that you received with the advance sheet for this subject. For most of the remainder of this hour we will discuss the various elements of this guide. Remember that the key word here is GUIDE, and that this format is designed primarily to systematize your thinking on this very important aspect of demolitions activity. It may be that you will find it necessary to change the format of the form you choose to utilize, depending on local conditions and the guerrilla force that you may encounter. As long

as a systematic procedure is followed, and the necessary information obtained, the format employed could hardly be of less importance.

NOTE

Discuss each element of the form with the class, stressing the problems involved. The requirement for accuracy and completeness of information will often have to be balanced against accessibility of the target and security requirements. Sketches of the surrounding terrain are extremely important, inasmuch as the report form will usually serve as the basis for developing the tactical plan in connection with the demolition task. Overlooking a small ditch or a few strands of wire could easily spell the difference between success and failure in a night raid, where split-second timing and coordination are required.

NOTE

At the conclusion of the discussion, a completed form is issued to the students. This form will contain the result of a comprehensive target reconnaissance and will reflect close attention to detail.

ON VGT 23

COMMENT

By way of a brief summary, let's examine the four considerations shown on this slide. We must consider all of these things, and a few others not listed, in determining exactly how we will attack any given target. The second point, "Extent of damage desired," is one that I have so far mentioned only briefly, if at all. If, for instance, we are charged with interdicting a highway system, and it is possible that friendly forces will soon be in the area, our instructions might be to inflict only partial damage on key bridges. This way enemy troop movements will be hindered, but friendly rebuilding of the bridges will be facilitated.

And we must not forget to consider all means of destruction at our disposal. If fire or some other type of sabotage will suit our needs, then by all means we should save our explosives and adopt the alternate method. Efficient and effective destruction of a target often requires studying the target system until you gain almost as much knowledge of it as the engineers who built it. In other words a knowledge of calculation and placement still isn't the whole answer to our demolitions problems. Next comes target selection, and on some target systems this poses no great problem. On others, highly technical knowledge will be required to enable you to attack key points.

Are there any questions? Dismissed.

UNITED STATES ARMY SPECIAL WARFARE SCHOOL

BRIDGE DEMOLITIONS

LESSON PLAN

1. CONCEPT. this subject is designed to give the student a working knowledge of bridge destruction through the use of explosives. The subject includes the following:

a. Consideration and planning for partial or complete bridge destruction, to include intelligence sources.

b. Nomenclature of fixed bridges, and the major bridge types. Abutment destruction, pier destruction, and destruction of superstructures.

c. Problem requirements are that the students plan specified levels of destruction, calculate the charges required, and plan their placement against a specific bridge.

2. COURSE SCHEDULE.

a. This subject is presented to the Special Forces Officer Course as the final demolitions subject in the course. Instructor must be thoroughly familiar with all previous demolitions subjects.

b. In the homework assignment the students will study appropriate selections, pertaining to bridge destruction, in FM 5-25. They review the material previously presented during 756, and solve problem requirements prior to coming to class.

c. Suggested time schedule:

H to H+ 5	Introduction to bridge demolitions, with emphasis on the special problems facing guerrillas in this field.
H+ 5 to H+ 10	Discuss the nomenclature of fixed bridges.
H+ 10 to H+ 25	Discuss the problems of abutment destruction and the methods employed.
H+ 25 to H+ 35	Discuss the problems of pier destruction and the methods employed.
H+ 35 to H+ 50	Familiarize the students with the eight basic bridge types, and with the locations for emplacing charges to destroy each.
H+ 50 to 1H	BREAK
1H to 1H+ 25	Continuation of above.
1H+ 25 to 1H+ 50	Introduce the specific bridge problem by distributing the general situation, answering any questions pertaining to it, and the first requirement. Discuss solution to first requirement.
1H+ 50 to 2H	BREAK
2H to 2H+ 25	Students work out answers to second requirement, and student work groups are called on for solutions which are discussed before the solution and next requirement are distributed.
2H+ 25 to 2H+ 50	Students solve third requirement, and solutions are presented and discussed.

2H+ 50 to 3H BREAK

3H to 3H-25 Students solve fourth requirement and solutions are presented and discussed.

3H+ 25 to 3H-50 Summary is distributed and discussed by the instructor. Summarize all material covered in past 4 hours.

d. Issue Plan

(1) Prior to class: Advance sheet and first requirement, Section I.
(2) During class:
(a) Section II, general situation and second requirement.
(b) Section III, solution to second requirement, and the third requirement.
(c) Section IV, solution to third requirement, and the fourth requirement.
(d) Section V, solution to fourth requirement, and the fifth requirement.
(e) Section VI, solution to the fifth requirement.
(f) Section VII, summary.

e. Conduct of Lesson
(1) Prior to class:
(a) Instructor. Review all previous demolitions instruction and gain a thorough understanding of bridge demolitions.
(b) Student. By studying the homework assignment and reviewing subject 756, he develops a general knowledge of the subject.
(2) During class:
(a) First hour:
1. Instructor lectures on the problems of bridge demolitions for a guerrilla force.
2. Lectures on nomenclature and types of bridges, problems of abutment destruction and pier destruction, and methods for destroying each of the eight major types of bridges.
(b) Second hour: Students solve requirement concerning intelligence sources for bridge reconnaissance. Students solve requirement to plan a specific level of destruction against a typical bridge target.
(c) Third hour: Students solve two more requirements each involving a different level of destruction. Instructor summarizes and answers questions.

UNITED STATES ARMY SPECIAL WARFARE SCHOOL

BRIDGE DEMOLITIONS

COMMENT

H to H+ 5

Good afternoon, gentlemen. To date in our demolitions training we have used the broad brush approach, often mentioning the specialized demo tasks which occupy the special forces demolitionist, but seldom coming to grips with any of them. During the next 2 hours we will delve a bit deeper into one specific field of demo work, bridge demolitions. A question that might well arise, and one that deserves an answer, is why select this specialty over the others? The reason is simply that a prime mission of a guerrilla force is to interdict enemy rail and highway systems; and there are no more lucrative targets in a transporation system than its bridges.

During the next 2 hours we will first become familiar with the various types of bridges, and then discuss the simplest and surest ways to render them unusable. Virtually everything that we have studied so far is applicable to bridge demolitions. We have learned how to cut steel and timber, how to breach reinforced concrete, and how to use pressure charges and cratering charges. So we already possess the essential tools for bridge destruction, and now only have to learn how to apply them against the different types of targets. While I say "only," this is really a far from simple task.

We use demolitions to destroy bridges to delay the enemy. Obviously the most completely destroyed bridges can be rebuilt IN TIME by a determined enemy. The factors which effect bridge demolitions by conventional forces are of necessity somewhat different than those affecting bridge demo by a guerrilla force. Disregarding the conventional approach to the problem, let's think of some considerations that will govern the EXTENT of destruction that a guerrilla force will plan for.

NOTE

Call on several students for opinions, and guide the discussion so that most or all of the following points are included: tactical, strategical, and even the local political situations; length of time desired to delay the enemy; bypasses available; time available on the target; compare results to be obtained with other possible attacks elsewhere; guerrilla manpower, equipment, and explosives available; and the possibility that friendly forces may reoccupy the area and require the bridge.

COMMENT

As I mentioned earlier during our class on Calculation and Placement, COMPLETE DESTRUCTION of a bridge will seldom be required. I will qualify that statement and add that it will seldom be required of a conventional force. It is difficult to imagine WHEN complete destruction would EVER be required of a guerrilla force, and we can dismiss the problem as one of little concern to us. We can make a general statement to the effect that

"in guerrilla operations we will usually seek the most economical ways to destroy bridges." We are vitally interested in economy of time and explosive, and for this reason such techniques as bridge abutment destruction will not often be attempted by guerrillas.

Beginning on page 152 and carrying over to the end of page 153 in FM 5-25, there are ten points listed that should be considered when planning a bridge demolition. All of these points, which you read in your reading assignment, are important to the conventional demolitionist, but they may not receive equal weight in the guerrilla's considerations. The one point that is equally important to both groups is the first one: "An individual qualified in bridge design and construction is best qualified to plan the demolition of bridges. Particularly in the case of large complex structures, such a person should be sought out to plan, or to assist in planning, demolitions."

COMMENT
H+ 5 to H+ 10

Very conveniently, the nomenclature of fixed bridges is divided into two main headings, each of which breaks down into four separate parts.

NOTE

ON VGT 1

COMMENT

The SUBSTRUCTURE is made up of ABUTMENTS, the ground supports at the end of the bridge. FOOTING is that part of a bridge support which rests directly on the ground; it distributes the load. END DAM is a retaining wall of concrete or masonry at the end of a bridge which supports the bank; it keeps the approach road from caving in. INTERMEDIATE SUPPORT is a support beneath a bridge between the abutments; a pier or bent.

The SUPERSTRUCTURE is composed of LOWER CHORDS, the lower members in a panel of a truss which run parallel to the deck. UPPER CHORDS include the upper members in the panel. STRINGERS run longitudinally with the bridge and directly support the deck. DECK and TREAD: the deck is the actual floor of the bridge with the tread being the top surface material.

NOTE

OFF VGT 1

COMMENT

While you don't necessarily have to memorize these terms, you should become familiar with the function of each component in a bridge. Much effort and many lives have been wasted because people charged with the demolition of a bridge did not know where to place the charges. Destroying the deck of a bridge while leaving the load bearing members intact is not bridge destruction; it's a minor annoyance.

COMMENT

H+ 10 to H+ 20

As I have already mentioned, we will not become too involved in bridge abutment destruction. However, we will spend a few minutes in familiarizing you with the basic rules for abutment destruction. Abutments by their very nature are difficult targets to destroy, requiring large amounts of explosive and much time and effort for emplacing the charges. They can be destroyed by either internal or external breaching charges, or by charges placed in the fill behind them. Whatever method is used, the entire width of the abutment must be destroyed if the demolition is to be effective. Demolition of abutments is especially effective where the topog-

raphy forces the enemy to use the existing site for a new abutment. This is an important consideration, one that might well dictate that abutment destruction be attempted.

Charges in the fill behind an abutment offers the advantages of economical use of explosives, and at times permits concealment of the charges. The principal disadvantage is the difficulty of emplacing the charges. If the fill behind the abutment contains large rocks, this method may be almost impossible for guerrillas to attempt. One technique that might be considered for rapidly sinking boreholes in this situation is the use of shaped charges. The M-3 or 40-pound variety would be best suited for this task. Of course the problems of securing the charges, transporting them to the target, and the noise associated with their use will have to be considered.

NOTE — ON VGT 2

COMMENT

Abutments 5-feet or less in thickness are demolished by a line of 40-pound cratering charges, 5-feet deep, 5-feet apart (center to center), and 5-feet behind the FACE of the abutment. To add one more five to the undertaking the first hole is placed 5-feet in from the side of the road. If the wing walls are strong enough to support a bridge in rebuilding, they should be destroyed in the same manner.

Abutments more than 5-feet thick are destroyed by breaching charges placed in contact with the rear face of the abutment. Charges are calculated by the breaching formula, $P= R^3 KC$, using the abutment thickness as the radius, R. Remembering the amounts of explosive required to breach walls in this category, over 5-feet thick, it's easy to see why guerrillas will not be able to attempt abutment destruction very often.

NOTE — OFF VGT 2

COMMENT

Abutments more than 20-feet high required, in addition to the breaching charges behind the abutment, a similar line of charges placed against the bottom front face of the abutment, and primed to detonate at the same time. This results in an overturning of the abutment, and its complete destruction.

COMMENT

H+ 20 to H+ 30

I think we have adequately covered the fact that we won't often attack abutments, but there is another concrete target that we may be required to destroy regardless of the difficulties or large amounts of explosive required. I'm referring to the destruction of intermediate supports, the piers or bents.

Destruction of one or more piers on multispan bridges is usually the most effective method of demolition. The destruction of one support will collapse the spans on each side of it, so that destroying every other pier will result in all spans coming down. Internal charges are best, but for guerrillas are impossible (for all practical purposes) unless demolition chambers exist.

As a refresher in the use of the breaching formula, work this problem and be prepared to present your answer to the class.

NOTE ON VGT 3

COMMENT The pier is constructed of reinforced concrete; compute the amount of TNT required for breaching. Now that we have the answer for one charge, let's briefly consider how we determine the total number of charges required to completely demolish the pier; remember we don't just want to knock a hole in it. The formula is:

$$N = \frac{W}{2R}$$

The N is the number of charges; W is width of pier in feet; R is breaching radius in feet. If N's value contains a fraction of less than $\frac{1}{2}$, it is disregarded; but if $\frac{1}{2}$ or greater, add a whole number. (An exception exists for N-values between 1 and 2; then $\frac{1}{4}$ is the dividing line.)

NOTE OFF VGT 3

COMMENT So far in this hour we have discussed the destruction of bridge substructures only. Bridge destruction begins to get somewhat complicated when it involves superstructures. During the next hour we will see slides of eight different types of bridges and some combination types as well. We will become familiar with the best locations for the charges to destroy each type, and we will work a few problems in calculation. Are there any questions at this time?

COMMENT

H+ 30 to H+ 50

While this rather bewildering array of bridge types might give the impression that bridge destruction is an over-complicated business, we will really be concerned with only the most common types of bridges.

NOTE ON VGT 4

COMMENT Some of the unusual and seldom encountered bridges are interesting, it's true, but their very rarity makes them worth no more than passing notice.

NOTE OFF VGT 4

COMMENT The stringer bridge, in which the stringers are the load-bearing members and the floor is dead load, is the most common type of fixed bridge in most parts of the world. Stringer bridges further divide into two sub-types, simple and continuous spans. In simple span stringer bridges, the stringers extend only from one support to the next. Cut stringers into unequal lengths to hinder salvage. This points up a principle of destruction that has universal applicability; destroy all of one type item in any target or target system. For instance, in destroying vehicles in a motor pool in a limited time, destroy all engines (as an example) to prevent cannibalizing and reconstructing.

To destroy continous span bridges, those that have beams which extend over more than two spans, we often have to cut EACH member in TWO places BETWEEN SUPPORTS. In other words, such bridges cut only once between supports may not fall, due to the rigidity and strength of the stringers. Continuous concrete T-beam or continuous concrete slab bridges can be recognized by the absence of construction or expansion joints over the supports. As you will recall, pressure charges on continuous beams give unsatisfactory results and should not be used. Such bridges should be attacked by demolishing the piers, by demolishing the junction between span and pier, or by removing all spans by cutting them at approximately one quarter of their lengths from each end. Breaching charges are used in all cases.

A T-beam bridge is essentially a concrete stringer bridge, with the floor and stringer being one piece, and the floor adding strength to the beam. This type may appear as a simple span, as a continuous span, or as a cantilever span.

NOTE — ON VGT 5

COMMENT — This simple span T-beam bridge is easily identified by the expansion joints over the piers; they can be destroyed by either pressure or breaching charges.

NOTE — OFF VGT 5

COMMENT — In this next slide, we see a continuous span T-beam bridge.

NOTE — ON VGT 6

COMMENT — This slide shows how a charge would normally be emplaced on this bridge.

NOTE — OFF VGT 6

ON VGT 7

COMMENT — Remember that this is a breaching charge, that it must be placed to breach the T-beam, that it is only one of five charges that would probably be employed against this particular bridge, and that the problems of holding these charges in place may prevent their use in guerrilla operations.

NOTE — OFF VGT 7

COMMENT — Having now seen a simple span and a continuous span bridge, let's look at a type of concrete cantilever bridge.

NOTE — ON VGT 8

COMMENT — If you will please look closely at the picture, you will be able to see the joints and note their placement. This particular type of bridge is called a "cantilever slab bridge with suspended span." Note the charge placement that is designed to cut the bridge and overbalance the supporting spans. Particularly note

how the suspended spans drop free, and we demolish five spans with only two cuts. Although cantilever bridge destruction appears to be relatively simple, such bridges must be carefully studied to determine the function of the members, so that maximum damage can be inflicted.

NOTE OFF VGT 8

COMMENT A truss is a jointed frame structure consisting of straight members, either steel or timber, so arranged that the truss is loaded only at the joints. They fall into two categories: deck-type and through-type trusses.

NOTE ON VGT 9

COMMENT In addition to this breakdown, truss bridges may be either simple or continuous span construction. This slide is a good example of a deck truss bridge. Charges would be placed on both

NOTE OFF VGT 9

ON VGT 10

COMMENT the upper and lower chords, and any diagonal members that might interfere with complete destruction. Seeing this locomotive on the bridge should remind us of the desirability of attempting to time our demolitions so as to utilize the tremendous weight of the train to assist in the destruction of the bridge. The fact that the train will also be wrecked, and that casualties will undoubtedly occur, is merely a desirable bonus.

NOTE OFF VGT 11

ON VGT 12

COMMENT As an example of a combination of types, this bridge, as you can see, is a combination of both the pony truss and through truss types.

NOTE OFF VGT 12

COMMENT Short of bringing a truss bridge down and then proceeding to cut it up into small segments, the type of complete destruction we are not concerned with, there are two main methods of destroying truss bridges. One is to cut the end posts and lower chords at both ends of one truss in each span. This causes the bridge to roll over, thereby twisting the other truss off its support. A trick of the trade in this method is to make the cuts on the upstream side of the bridge so that, if possible, the current will assist in the twisting action and make destruction more complete. The other method is to cut all major members in midspan. This means cutting both upper and lower chords on both trusses and diagonal members that might impede destruction.

NOTE ON VGT 13

COMMENT Now contrast that charge placement with these charges shown on this continuous span through truss bridge.

NOTE OFF VGT 13

ON VGT 14

OFF VGT 14

COMMENT In addition to the types of truss bridges that you have just seen, there is one more type that we might encounter--cantilever truss bridges.

NOTE ON VGT 15

COMMENT Cantilever truss bridges are really a modification or refinement of continuous truss or continuous beam bridges, and the principles for the destruction of those types of bridge also apply to cantilever bridges.

NOTE OFF VGT 15

COMMENT To further complicate this already complicated situation, cantilever truss bridges are found either with or without suspended spans.

NOTE ON VGT 16

COMMENT In this slide we see the relatively simple problem of destroying the suspended span cantilever truss bridge. By merely placing the charges on the hangers we are able to drop the span. (These are major bridges.)

NOTE OFF VGT 16

ON VGT 17

COMMENT On a cantilever through truss without a suspended span, we place charges to destroy the connection and, as you see here, to further cut this long truss near the pier.

NOTE OFF VGT 17

COMMENT We have one more set of terms to study to understand another major classification of bridge, the arch type. Common sense tells us, and rightly so, that the best place to attach arch

NOTE ON VGT 18

bridges is at the crown where the arch is thinnest. While charges are easily placed at the crown, repairs are also easily made across the narrow gap produced. So the second method of placement of charges, at the haunches, while more demanding in terms of time and explosive, is also more destructive.

NOTE OFF VGT 18

ON VGT 19

COMMENT This slide shows a typical solid masonry arch bridge. In contrast to this solid type of bridge, there is a filled spandrel arch type. The next two slides show two methods of placing charges to destroy this type of bridge. The difference in difficulty of emplacing crown and haunch charges can be readily seen by comparing these two pictures.

NOTE OFF VGT 19

ON VGT 20

OFF VGT 20

ON VGT 21

OFF VGT 21

COMMENT The final major class of bridge that we will discuss this afternoon is the suspension bridge. Small suspension bridges present no major problems in destruction, and cutting the cables will usually be the quickest way to put such bridges out of action. But large suspension bridges, such as shown here, are quite another matter.

NOTE ON VGT 22

COMMENT The cables are often too large to cut with explosives, and the towers are so massive that tons of explosive would be required to destroy them. So while suspension bridges provide an interesting demolition problem, it is apt to be more of a theoretical problem than a practical one for guerrillas.

These last three slides are examples of three more bridges that are variations of those already discussed.

NOTE OFF VGT 22

SHOW VGT's 23, 24, and 25 in sequence.

COMMENT Each of them present unique problems in destruction, and all would probably require the major type of effort not within the capabilities of guerrilla units except under peculiar conditions.

During the past 2 hours we learned some bridge nomenclature, became acquainted with various types of bridges, with emphasis on the more commonly encountered types, and briefly touched on methods to destroy them. During a guerrilla combat

operations class you will be given the opportunity to apply some of this very general knowledge, along with specific cutting and breaching techniques to destroy a bridge with all necessary information being supplied.

Remember that we are not thinking of bridge destruction as an academic problem; or put another way, our planning will not be conducted in a vacuum. Bridge demolitions should be planned so that the enemy is denied the use of the bridge at a critical time. Coordinated destruction, or destruction that is directed by the sponsoring power to coincide with an action having tactical or strategical importance will do the most damage to the enemy. Are there any questions?

COMMENT 1H to 1H+ 25	The situation and requirement now being handed out to the class is to be used in conjunction with the charts placed at your tables. Take a few minutes to read the material and I will answer questions regarding it before you begin to consider an answer to the first requirement.
NOTE 1H+ 25 to 1H+ 50	Students are given about 15 minutes to consider the intelligence sources and agencies. Individual students are called on to supply their answers, and the instructor attempts to insure that all major points contained in the solution are covered.
1H+ 50 to 2H	BREAK
NOTE 2H to 2H- 25	Section III is issued and the students are told to work out their solution to the second requirement so that they can be presented by study groups after 15 minutes. The instructor insures that the key points of the solution are developed in the course of monitoring the student discussions.
NOTE 2H+ 25 to 2H+ 50	Section IV is issued and the procedure outlined above is repeated.
2H+ 50 to 3H	BREAK
NOTE 3H to 3H+ 25	Section V is issued and the same procedure is again followed.
NOTE 3H÷ 25 to 3H+ 50	Section VI and VII are issued. The solution to the fourth requirement is briefly reviewed by the instruction and the students are told to glance over the summary and feel free to ask any questions they desire regarding it.
COMMENT	An important point to remember in connection with all of this instruction is that such demolition problems are more than a little difficult for a good U.S. team. This fact is quite evident to me when I find that all officer classes make mistakes in their calculations or do not select the proper locations for placement of the charges. So if a special forces detachment finds the technical aspects of bridge destruction a problem, it is easy to imagine the difficulties encountered in trying to train guerrillas for the task.

The difficulties are increased if the guerrillas happen to be illiterate, a not unusual situation. If you, the personnel of the detachment, must be present to actively supervise and perform the demolition tasks, the potential of your guerrilla force will be severely limited. You could find yourself in the position of having 1,000 guerrillas that could only carry out one or two significant raids simultaneously, involving the use of demolitions. When considering the problems of training the guerrillas, remember that you will not be operating in a clean and pleasant classroom environment. The time available for the training may be limited. There will almost certainly be a language barrier, and practical work may be ruled out for security reasons (demo is noisy). Then when your guerrillas arrive at their objective at night, and demo work is greatly complicated by darkness, and they are subjected to the strain of enemy action, it is not difficult to see how they might fail. YOUR job will be to see that they do not fail.

UNITED STATES ARMY SPECIAL WARFARE SCHOOL

ADVANCED TECHNIQUES

LESSON PLAN

1. CONCEPT. This subject is designed to give the student a working knowledge of the procedures and techniques used in the construction and employment of demolition charges in the advanced technique category. In addition, unclassified new developments in demolitions are presented and discussed. This subject includes:

a. The value and limitations of advanced techniques.

b. Advanced techniques for steel cutting to include the saddle, diamond, ribbon, and linear shaped charges.

c. Advanced breaching techniques to include the opposed and square charges.

d. Advanced technique charges for destroying volatile fuel containers, to include the platter charge.

2. COURSE SCHEDULE.

a. This subject is presented to the Special Forces Officer Course. Instructor must be familiar with all previous demolitions instruction.

b. In the homework assignment, the student reviews subject U3. T7508, Introduction to Demolitions, and U3. T7704, Calculation and Placement of Charges.

c. Suggested time schedule:

H to H+ 15	Introduction including familiarization with advantages and limitations of advanced techniques.
H+ 15 to H+ 55	Discuss and demonstrate construction of saddle and diamond charges, which will be detonated so that their results can be examined by the students.
H+ 55 to 1H+ 5	BREAK
1H+ 5 to 1H+ 45	Discuss and demonstrate the construction of ribbon and linear shaped charges, which will be detonated so that their results can be examined by the students.
1H+ 45 to 2H+ 5	BREAK
2H+ 5 to 2H+ 25	Discuss and demonstrate construction of the opposed charge and the ERDL square charge, which will be detonated so that their results can be examined by the students.
2H+ 25 to 2H+ 50	Discuss and demonstrate construction of the platter charge, which will be detonated to demonstrate its effectiveness.
2H+ 50 to 3H	BREAK
3H to 3H+ 45	Discuss and demonstrate new developments in demolitions, both equipment and techniques, to include EL 506, sheet explosive.
3H+ 45 to 4H	Issue summary and answer questions regarding it.

d. Issue Plan:

(1) Prior to class: Advance sheet.

(2) During class: Summary.

e. Conduct of lesson:

(1) Prior to class:

(a) Instructor. Read all special material from ERDL and review all past demolition instruction. Read chapter 1, FM 31-20.

(b) Student. Review all previous demolition instructional material.

(2) During class:

(a) First hour: Instructor lectures on capabilities and limitations of advanced technique charges and demonstrates the construction and use of saddle and diamond charges.

(b) Second hour: Instructor lectures on difficulties of steel cutting and demonstrates the construction and use of ribbon and linear shaped charges.

(c) Third hour: Instructor demonstrates and explains the construction of an opposed charge, the ERDL square charge, and the platter charge.

(d) Fourth hour: Instructor lectures on new developments in demolitions.

UNITED STATES ARMY SPECIAL WARFARE SCHOOL

ADVANCED TECHNIQUES

COMMENT

H to H+ 15

Good morning, gentlemen. Welcome back to Coleman Demolition Range. I know you would be disappointed if any range day failed to start with a bang, and the attention charge just detonated is designed to prevent such disappointment. It should also serve once again to remind you that we will be working with live demolitions on this range and that you should be safety conscious throughout the day. This morning we will be discussing various advanced techniques for steel cutting, concrete breaching, and for destroying volatile fuel containers. Most of the charges will be covered by means of explanation and demonstration of their construction, followed by a demonstration of their capabilities against specific targets, and you will be able to observe their results. Before getting into a discussion of the first two charges, I want to briefly remind you of some of the advantages and limitations of charges classed as advanced technique charges. Although there may be other lesser advantages in the employment of advanced techniques, the two primary advantages are: (1) they almost invariably use less explosive than conventional charges, and (2) their results are more positive.

The two primary disadvantages encountered are: (1) advanced technique charges require more time to prepare and emplace, and (2) the charges themselves are often fragile. The point to remember here is that these charges will neither be automatically used because of their effectiveness, nor automatically discarded because of their drawbacks. The demolitionist in the special forces detachment will be thoroughly conversant with these advanced techniques. Faced with a specific demo task, he is well qualified to select the charge best suited to accomplish that task. Preparing the charges in advance, before the target area is even entered, will often provide the answer.

It should be remembered that information concerning the target, in that case, must be fairly exact. Also the problems of transporting a fragile charge over difficult terrain during a night combat operation may prohibit its use. In guerrilla demolitions operations, probably more than any other, the charges selected will be a compromise.

COMMENT

H+ 15 to H+ 55

As indicated during previous instruction, cutting steel by the use of explosives is not an easy task. Aside from the obvious strength and hardness of the metal, there is another complicating factor that adds to the difficulty and that is the wide variety of configurations that might be encountered. Cutting irregularly shaped steel sections (and don't forget the requirement that the explosive must make maximum close contact with the target) is a problem more difficult than any other in demolitions work. Because of the requirement for close contact between the steel and explosive, TNT and tetrytol will always have to be a poor second choice if a composition explosive is available. C-4, with its plasticity and high detonating velocity, is by far the best standard military explosive for the job. To cut a steel target like this typical I-beam is no great problem regardless of which high explosive is used.

NOTE

A short length of steel I-beam is displayed on the instructor's table.

COMMENT

As you will remember from our discussion of steel cutting in the calculation and placement class (U3.T7704), we would use the formula $P = \frac{3}{8}A$, find the cross sectional area of the beam in square inches and the resulting answer would be the number of pounds of TNT required to cut this target. TNT, with its flat surfaces, can easily be emplaced to get good contact with this target, as you can see here. Traditionally, the most difficult steel targets have been those that are round. Round targets, such as turbine shafts, are not only difficult in terms of their shape, but the metal employed in their construction is exceptionally hard. To cut a round turbine shaft just 1-foot in diameter requires a large amount of explosive, using conventional techniques; and, even with a substantial overcharge, the results cannot be assured. There are two advanced charges that have been designed specifically to cope with this problem, and they are the saddle and the diamond charge. While these charges are similar to teach other, there are enough differences in construction, functioning, and purpose to clearly set them apart. We will begin by discussing the saddle charge. When completed, the charge, ideally, should look like this.

NOTE

Show a mockup of a saddle charge prepared and emplaced on a short length of steel about 6 to 8 inches in diameter.

COMMENT

To arrive at the point where this finished product is ready to be detonated requires some knowledge of how to prepare the charge and a great deal of patience and skill to actually construct it. The dimensions of the charge, when completed, has the shape of an isosceles triangle, as follows: The short axis, or base, is

approximately one-half the circumference of the target. The long axis is equal to the circumference of the target. The thickness of the charge is 1/3 block of C-3 or C-4 on targets up to 6'' in diameter. On targets 6'' to 8'' in diameter, use ½ block of C-3 or C-4. Functioning of the charge is as follows: the charge must be primed at the apex of the triangle, with the cap pointing straight down the shaft toward the base. When detonated, the shock wave moves toward the base of the charge; and when it arrives at the base, the target is cut at that exact point by an action known as "cross fracture." Some techniques that can be used to prepare the charge are simple but helpful aids in what is a difficult task. A piece of string or cord should be used to determine the measurements of the charge. A large piece of cardboard, or similar material, should then be used and a simple outline of the charge drawn. Remember to carefully slice the explosive so as not to disturb the density of the pressed blocks. Arrange the C-4 on the template so that it is uniformly solid to a thickness of one-third or one-half thickness of a block of C-3 or C-4 Throughout its entire length and width. Transferring the charge onto the target without disturbing it or having it break up is a difficult task under the best conditions. In either extremely cold or extremely hot temperatures, preparation time will be greatly increased. A material like aluminum foil makes a fine protective covering for wrapping and moving these charges. When foil is not available, some substitute such as parachute cloth should be found, especially if the charge is not going to be detonated right away. Care should be exercised in priming the apex of the charge and all normal safety precautions for steel cutting must be observed. Due to the missile hazard and the highly lethal nature of those missiles, steel is probably the most dangerous target in demolitions.

Before proceeding to the diamond charge, take note of some peculiarities of the saddle. One, it is a comparatively long charge, and at times the entire length of the target available to be worked on may not permit meeting these specifications. Secondly, its single point of detonation contributes to its relative ease of construction and employment WHEN COMPARED TO THE DIAMOND CHARGE. And last, the only materials absolutely required to prepare this charge are C-4, a cap, either electric or non-electric, and a means of detonating the cap. Now we will turn to the diamond charge, and in the course of discussing it, we will point up similarities and differences.

To begin with, the target for the diamond charge will again be a round one; and again it can be a turbine shaft of the hardest grade of steel. The first difference worth noting is that the total length of the target that is exposed may not be capable of accommodating the long axis of a saddle charge. As you will see in a moment, the diamond occupies far less linear space on the target. Again using a cord to measure the target, find the circumference of the shaft. The circumference of the shaft and the length of the long axis of the diamond will be identical, as you can see it here emplaced on this mockup.

NOTE

Show a mockup of a diamond charge on a round cardboard or wood shaft.

COMMENT

One-half of this distance, the circumference, will be the measurement of the short axis of the diamond. Thickness of the charge is one-third thickness of a block of C-3 or C-4 for the hardest steel, regardless of its size. Again, the technique of making a template and forming the charge in a convenient working location should be used. Once made, and experience will dictate the amount of extra length needed to circumscribe the target so that the ends MEET on the far side, difficulties can be expected in transferring the charge to the target. Some form of wrapping should be used, and a good grade of tape will be quite helpful.

Another difference between the diamond and saddle charges is the requirement to prime the diamond at each point of the short axis. This should be accomplished by using EQUAL lengths of detonating cord, each with a non-electric cap crimped to one end. Cap wells are carefully made in the points of the diamond, preferably with the awl end of the crimpers, and the caps are inserted. The two free ends of detonating cord are then joined and exactly matched; and a cap is placed between them, point toward the charge. This meeting point of the cap and two lengths of detonating cord is carefully taped, and, given a method of detonating the cap, the charge is ready to be detonated. When the cap detonates, the two pieces of detonating cord carry the detonating wave to the short axis of the diamond simultaneously. The shock waves proceed through the body of the explosive until they meet at the exact line here in the center of the long axis. At that point they are deflected downward, providing a clean cut through the target. So, in addition to the added time required to make a diamond charge as opposed to the saddle, we have one more difference; the requirement for some additional items of equipment. Specifically, we will need a minimum of three caps, two of which must be non-electric; and we will need detonating cord. Both charges are extremely effective; and if time and material are available, their construction will pay dividends through their positive functioning. Are there any questions before we move to the firing area to observe two charges in place and ready to be fired.?

NOTE

The class is moved to the vicinity of the charges, where they can see the targets with the charges in place. The students then move back to the safety bunker while AI's fire the charges. When the all clear has been given, the students are again permitted to move to the firing area to examine the results of the charges. Questions are answered in the firing area by the instructor and assistant instructors, and the class then moves back to the vicinity of the bleachers where they are given a break.

H+ 55 to 1H+ 5

BREAK

COMMENT

1H+ 5 to 1H+ 45

Realizing that the saddle and diamond charges are highly specialized charges applicable to only one type of steel target, we will discuss two more advanced techniques capable of being used against sheet steel. To go back to our I-beam example,

NOTE

Again display the same short section of I-beam used in the first hour.

COMMENT

cont'd

There is a way to cut this beam, using less explosive, but a different technique from the bulk placement we mentioned in the last hour; in fact, there are two ways. One employs even less explosive than the other; true of many advanced charges, the price we pay to effect savings of explosives is more time in preparation. The first method we will discuss is the ribbon charge. Very simply, the dimensions of the ribbon charge are as follows: the THICKNESS of the charge is the same thickness as the target, but never less than ½ -inch thick. The width of the charge is twice the thickness of the target, and the length of the charge is the length of the cut desired. All of these dimensions are approximate, using this rule of thumb. This charge is primed from either end; and if the dimensions are such that a cap cannot be inserted into the end of the charge, it should be laid on top and a small additional amount of explosive used to cover it. These charges are very effective, but they present some problems in slicing the explosive to a uniform thickness, especially in either temperature extreme. Also they present some problems, as do almost all charges, in holding them in place against a target. The addition of tamping does little to increase their effectiveness, another characteristic of advanced technique charges. One last drawback is that ribbon charges are usually fragile; and if other charges are to be detonated in the area, they should be wrapped in some type of protective covering. Are there any questions before we go on to our next charge?

This next charge is one for which there is a rule of thumb; but it is stated in only very general terms, and trial and error is absolutely necessary to obtain any kind of predictable results. This charge is the linear shaped charge.

NOTE

Several types of charges, prepared in advance, will be placed on the instructor's demonstration table; and as each charge is discussed during the course of the class, the appropriate charge is shown, and its specific characteristics are pointed out.

COMMENT

The easiest dimension to come by, of course, is the length of the charge, which again is simply the length of the fracture desired. Several methods can be used to construct linear charges. One is very similar to the rule of thumb used in the construction of improvised shaped charges in our last range class. All we do in this case is cut a cavity in a block of C-4, with the angle of the cavity between 30 and 60 degrees, and an angle of about 45 degrees preferred. The height of the explosive should be twice the height of the cavity, measured from its base. Linear stand-off distance should be from one to two times the width of the cavity. For best results a metal liner should be formed from a thin soft metal, preferably copper. Prime the charge from one end, and it gives excellent results against sheet steel up to 2-inches thick. By excellent results, I mean that the cut will be clean along its entire length.

Another simple linear charge can be constructed by merely laying out an undersized ribbon charge (with a width no more than the thickness of the target) and forming the cavity by using a piece of smooth cord or rope pressed firmly into the bottom center of the charge. No stand-off distance is necessary and, on relatively thin targets of up to about ¾-inch, a clean cut is produced directly below the cavity's location in the charge.

A last expedient linear shaped charge that is worth mentioning is the flexible variety. To make this one, a piece of pliable rubber or plastic hose is required, at least 1-inch in diameter. First, a strip of the hose, from 1/3 to 1/4 of the hose circumference, is cut away and discarded. The space thus revealed is then filled with C-4, packed in as tightly as possible. The best method of forming the cavity is to cut a wooden wedge and press it firmly and uniformly along the length of the charge. The flexible, linear-shaped charge is then capable of being directly affixed to a circular steel target of relatively large circumference, but of thin metal (no more than ¾-inch). The charges primed from one end should result in a clean cut. While the flexibility of this charge is quite limited, actually, it can be handled and transported into a target area much more easily than the other charges we have discussed so far this morning.

NOTE

At this time the ribbon and linear shaped charges are placed on targets down-range and detonated by AI's. Everyone on the range will take cover in the safety bunker during firing.

1H+ 45 to 2H+ 5

BREAK

COMMENT

2H+ 5 to 2H+ 25

During the past 2 hours we have discussed advanced techniques for steel cutting and, before proceeding, are there any questions about anything we have covered?

During this hour we will be concerned with several different types of charges and three main types of targets, none of which are steel. First, I would like to briefly refresh your memory with a quick review of the main points involved in construction the opposed charge and the ERDL square charge, both of which are

Its potential was immediately seen by the people at ERDL; and, with a few small refinements, it is being adapted for military use. To begin with, the explosive loading consists of PETN. In the manufacturing process, the PETN is uniformly distributed throughout the flexible sheets so that uniform density is assured. It is pliable, as you see here, and it takes exceptional temperature extremes to affect it adversely. It can be cut to any desired shape, close contact with the target is easily obtained, and it can be built up in layers to cope with varying target thicknesses. To date there are no formulas or rules of thumb for using sheet explosive, but tentative results indicate that it is almost twice as effective as C-4. This adhesive backing, similar to the principle of the "Band-aid," is an especially valuable advance. Remembering that it could easily take two trained demo men more than 30 minutes to construct a saddle charge from C-4 (over an hour in cold weather), it is interesting to note that one man could construct a more efficient charge from sheet explosive in no more than 10 minutes. And with the addition of this glue, the explosive can be securely affixed to metal UNDER WATER. If there is an ideal explosive for steel cutting, this is it. Included in the kit is an improved package of C-4. As you can see, it is conveniently sized; that is, it is precut to a 1-inch thickness; and, for easy computation, it is a 1-pound block. The adhesive idea has proven so effective that it has been incorporated into the plastic covering for the C-4. It can be used or not at the discretion of the demolitionist. We have one more requirement that is presently well on its way toward being satisfied, and that is for an improved detonating cord. The improvements we are seeking are simple. One is that we want a fabric covering, like that found on the old detonating cord, that will be easier to knot. And second, we want the cord to be camouflaged. The dead white color of our present pliofilm wrapped cord presents certain problems in setting up ambushes that the manufacturer says he can solve easily. For general army-wide use in normal blasting operations, the present standard cord is completely acceptable; but, for special warfare applications, a camouflaged cord is a definite requirement. One last item of equipment that is under development is one that is not at all dramatic, but it is nevertheless one that we think has great possibilities. Very simply, it is an all purpose cap. It is a single cap that can be fired either electrically or non-electrically, with only one simple manual adjustment. These caps, prototypes of which have already been built, are very similar in appearance to our present non-electric caps. The addition of an electric squib into its base would transform it into an electric cap. The price would be about 50 cents each which, for our limited special warfare use, is quite reasonable. It would permit more flexibility in both the planning and use of explosives in the field. One additional small advantage is that it reduces by one the number of items in the supply system. At a time when we are constantly getting more and more gadgets, this is a refreshing trend. Another development, and this one is in the dramatic category, is AEREX. Except for nitroglycerine and, under certain conditions, gasoline, we don't have a liquid explosive available. It doesn't require any great amount of imagination to see that nitro is impractical. AEREX, which was developed by the Aerojet Corp of Azusa,

California, is a liquid explosive that is safe to transport and handle, and yet it has a detonating velocity in the 20,000-feet-per-second-neighborhood. The explosive consists of a widely available re-agent which, by itself, is no more dangerous than, for instance, naptha.

To this re-agent a small amount, about the equivalent of 6 per cent of the whole, of sensitizing agent is added. At that time AEREX becomes a RELATIVELY insensitive explosive. The only interest shown in AEREX to date has been by UDT, and one proposed use is for blasting coral. A small shaped charge would make the borehole into which the AEREX is introduced. Solid explosives have to be tamped into the hole, and any obstructions greatly limit the amount of explosive used. The liquid AEREX on the other hand seeps into every crevice in the borehole; and, if detonated soon thereafter while its concentration remains high, the results are excellent. It can be transported in flexible hoses, cans, drums, and so on. By not adding the sensitizer until just before using, it is a very safe explosive to handle. One type of employment, for what admittedly would be a highly specialized example, would be to introduce the AEREX into the cooling system of a vehicle for an assassination mission. From there it is a short and logical step to imagine ways and means for introducing it into the plumbing system or steam heating system (during warm weather) of a building. Effects of every inch of piping detonating simultaneously in a building can well be imagined. These are a few simple uses that come to mind after a minute or two of deliberation, and your imagination should suggest many more.

Another development is paste explosive which has been both developed and tested by ERDL. Paste explosive is essentially a plastic explosive to which has been added a binding agent. The resultant paste is extremely sticky and when used in conjunction with a special type of calking gun, it can be squeezed directly onto the target where it sticks very well. Columns thicker than 1-inch of paste explosive have a tendency to fall apart, and tests are underway to solve this problem. The paste applied to steel and left in the weather for several months detonated successfully at the end of the testing period, and paste explosive seems to have some potential for specialized demolitions tasks. To return briefly to our discussion of sheet explosive, I want to show you one ideal use for it in preparing an expedient charge. As you can see here,

NOTE — Show different types of linear shaped charge.

COMMENT — it is ideal for making linear shaped charges. The best technique seems to be to first form the cavity from some soft metal and then cover it with one or two layers of EL 506. We will now move out into the firing area to observe the placement of several linear shaped charges. Before we move out, are there any questions?

NOTE — The charges are fired and their results are then viewed by the class after the range has been determined to be clear. The class is then reassembled in the bleachers.

COMMENT

3H- 45 to 4H

The summary for this class has just been distributed, and I would like you to take a minute to discuss it with you. Feel free to ask any questions you may have about the (morning's) material. This whole field of advanced techniques and the new developments that have already emerged only point up how far we still have to go. It is a fertile field, and one that is wide open to experimentation. No single agency has a monopoly on creating new techniques, and I would like to urge you to continue to think about improvements and new methods.

UNITED STATES ARMY SPECIAL WARFARE SCHOOL

INSURGENCY DEMOLITIONS

LESSON PLAN

1. CONCEPT. This subject is presented as a 4-hour class on the demolition range. It is designed to familiarize the student with a variety of casualty producing charges, most of which are equally capable of being employed either by or against insurgent forces. The student will be familiarized with explosives, incendiaries, firing devices, and the necessity for denying the insurgent access to the materials necessary for their construction is emphasized.

2. COURSE SCHEDULE.
   a. This subject is presented to all counterinsurgency students.
   b. Suggested time schedule:

H to H+ 10 — Introduction and administrative announcements.

H+ 10 to H+ 50 — Incendiaries--the following are mixed, explained and demonstrated in view of the students.

1. Potassium, chlorate, and sugar.
2. Potassium, permanganate, and sugar.
3. Iodine crystals and aluminum powder.
4. Sawdust and wax.
5. Napalm, soap, and gasoline.
6. Flower pot incendiary.
7. Molded incendiary.
8. Soap dish.

H+ 50 to 1H — BREAK

1H to 1H+ 50 — Pipe bomb, satchel charge, and firing devices.

1. Standard firing devices and detonators:
   a. M10 universal high explosive destructor.
   b. M1 delay firing device
   c. M1 pull.
   d. M1A1 pressure
   e. M5 pressure-release.
   f. M3 combination.
   g. 8- and 15-second delay detonators.
2. Improvised firing devices:
   a. Open loop.
   b. Water can.
   c. Clock.
   d. Electrical screen.
   e. Clothespin.

1H+ 50 to 2H — BREAK

2H to 2H+ 50 — Improvised firing of 3.5-inch rocket. Issued and improvised cratering charges. Bangalore torpedo in antipersonnel role.

M2A3 and M3 shaped charges in antipersonnel role.

2H+ 50 to 3H — BREAK

3H to 3H+ 20	Walk through of demonstration area and explanation of the following: 1. Detonating cord in ditch. 2. Grape-shot. 3. White phosphorous ambush. 4. Demolition ambush.
3H+ 20 to 3H+ 30	Conduct spot quiz.
3H+ 30 to 3H+ 45	Fire demonstration charges.
3H+ 45 to 4H	Issue summaries; closing statement and target inspection.

UNITED STATES ARMY SPECIAL WARFARE SCHOOL

INSURGENCY DEMOLITIONS

INTRODUCTION

NOTE — Fire attention charge.

COMMENT

H to H+ 10

Good ________ gentlemen. Welcome to Coleman Demolition Range. The attention charge that was just detonated downrange should serve to remind you that we will be working with live explosives on this range throughout the period of instruction.

This is a range like any other, and, if anything, more dangerous than most. By way of introduction to the range and the procedures to be followed while here, note the locations of the safety bunker, latrine, and the firing area. Smoking is permitted in the bleachers, but not forward of them. Smoking in the vicinity of my podium and this work table is strictly prohibited. You are encouraged not to take notes during this instruction, for several reasons. In addition to the difficulty of taking effective notes while in the bleachers, you may be writing while listening would be more appropriate. A teaching point summary will be distributed during the last hour that will contain the salient points that you are expected to retain.

I encountered something of a problem in attempting to develop a class that would be both meaningful and interesting for a group that is primarily concerned with counterinsurgency. Before proceeding I want to acquaint you with our approach to this problem.

One of our most distinguished enemies, Mao, has said that "the first duty of a guerrilla, is to survive." I consider that it is completely logical to paraphrase this excellent maxim and state that staying alive is also the first duty of the counterguerrilla. Another Chinese military thinker from an earlier era, Sun Tzu, advises us to "know your enemy." By now you have heard enough about the necessity for gathering accurate, comprehensive and timely intelligence in order to effectively combat guerrillas. One aspect of getting to "know your enemy" is learning what weapons

he employs, how he employs them, where he employs them, and when he employs them; in short, his tactics and techniques. Explosives, properly employed, can be extremely effective weapons in the guerrillas' arsenal. A prime purpose of this instruction is to acquaint you with typical charges and devices that you can expect guerrillas to employ against you. If you know your enemy to the extent that you know what to expect by way of offensive actions from him, you will be better prepared to defeat him.

It is obvious that practically all of the casualty producing charges that we will explain today are equally capable of being used both by and against guerrillas. Too often the use of demolitions by a counterguerrilla force lacks imagination and is restricted to conventional mine employment. A secondary purpose of today's instruction is to provide you with information that will make counterguerrilla operations more effective.

Our Special Forces doctrine for guerrilla warfare takes into account the fact that resupply of guerrillas will often be difficult, and occasionally impossible. Our doctrine states that when guerrillas we are sponsoring are cut off from outside sources of supply, they have two alternatives for obtaining the required explosives. The first and most obvious solution is to obtain what is needed from a well-known local source, the enemy; however, if we cannot obtain explosives by local purchase, combat operations, or various clandestine means, then we have the ability to fabricate explosives, incendiaries, and delay devices from materials that are locally available. It seems safe to assume that most guerrilla forces that we are apt to encounter will have this same capability.

The necessity for safeguarding all stocks of explosives, ammunition, bombs, and mines needs no elaboration but, the vast multitude of materials that can be used to manufacture improvised munitions poses a tremendous problem for security forces. Instituting controls over the hundreds of items involved can severely tax the resources of any counterguerrilla force. We teach that a guerrilla force should stockpile significant amounts of the materials required before beginning operations with improvised munitions. We feel that it is safe to assume that enemy guerrillas will operate along similar lines. If security forces do not begin to control the materials until after the first attacks, they may well find themselves lacking an empty barn.

H - 10 to H+ 50

INCENDIARIES

NOTE

CAUTION: As a general rule, improvised explosives and incendiaries are much more dangerous to handle than conventional explosives. Such mixtures as the chlorate-sugar mix mentioned below can be ignited or detonated by a single spark, by excessive heat, or merely by the friction generated by mixing ingredients together. The danger in handling these items cannot be overemphasized. Care should be taken to see that this information does not become available to children.

COMMENT

1. Chlorate-sugar mixture can be either an incendiary or an explosive. Sugar is the common granulated household variety, while the chlorate may be either potassium chlorate or sodium chlorate; potassium is preferred. Proportions CAN be equal parts by volume, or 3 parts of chlorate to 2 parts of sugar, which is preferred. Mix in or on a non-sparking surface. Unconfined, this mix is a fast burning incendiary, often called a first-fire mix. Confined in a tightly capped length of pipe, it will explode when a spark is introduced. Such a pipe bomb definitely can produce casualties, but it will not be suitable for breaching or cutting tasks. Concentrated sulfuric acid will ignite (or detonate) the chlorate-sugar mixture. Placing the acid in a gelatin capsule, balloon, or other suitable container will provide a delay. The length of the delay depends on the time it takes the acid to eat through the container, which in turn depends to a great degree on the prevailing temperature. In very hot weather the acid will attack the container rapidly, and in very cold weather, the reaction will be greatly slowed. Once ignited, this mixture burns at approximately 3200 degrees.

NOTE

Demonstrate ignition of the chlorate-sugar mix using a match, sulphuric acid, and time fuze.

COMMENT

2. Another fast-burning, first-fire mix is obtained by mixing 9 parts potassium permanganate to 1 part sugar. It is somewhat hotter than the chlorate-sugar mix, and can be ignited by the addition of a few drops of glycerine. This mixture burns at about the same temperature as the chlorate-sugar mix.

NOTE

Demonstrate ignition of the permanganate sugar mix using glycerine and explain that sulphuric acid and spark will also ignite this mix.

COMMENT

3. Another mixture which burns slower, but hotter than the two previously mentioned, is iodine crystals and aluminum powder which is mixed half and half. This mixture is ignited by only a small drop of water.

CAUTION: Be sure that mixing utensils are clean and thoroughly dry. Once ignited the mixture puts off a bright purple smoke which is deadly poison. This mixture may be used to mark drop zones or landing zones in the absence of issued smoke grenades.

One way to employ this mixture as an incendiary is to place some of the mixture on the roof of a building during the day when the roof is dry and as night falls the dew deposited on the mixture will cause combustion thereby setting the building afire.

NOTE

Demonstrate ignition of iodine and aluminum powder with a drop of water. CAUTION: Place down-range and down-wind from the students.

COMMENT

4. A simple combination that is effective, and a long burning incendiary, can be produced by merely adding molten wax or tar to sawdust. Once ignited, this incendiary produces a long lasting flame. This incendiary must be ignited by a flame or by placing a small amount of one of the first-fire mixes on the sawdust and ignite this mixture with time fuze, acid, or an electrical squib.

NOTE

Demonstrate burning a small amount of wax and sawdust mixture by ignition with first-fire mix as previously described.

COMMENT

5. Napalm--soap and gasoline. Napalm is an excellent casualty producing agent, but the manufactured napalm powder may obviously not always be available. An expedient napalm is easily made as follows: To either gasoline or kerosene add finely cut soap chips. (Pure SOAP must be used, not detergents.) WORKING IN THE OPEN and exercising reasonable care, heat the fuel so that it comes to a boil and then simmers. Stir constantly until the desired consistency is reached, remembering that it will continue to thicken as it cools. An improvised double boiler gives the best results for heating the gas, and however this is done, you must be careful not to ignite the fuel. A carefully controlled bed of coals generally works well. Again, extensive trial and error experimentation will be required to determine the best consistency and mixing methods. This mixture can easily be ignited by a small flame or electrical squib.

NOTE

Demonstate burning a small amount by igniting with a match.

COMMENT

6. Flowerpot incendiary: This is a device to be used on steel targets such as machines, motors, or POL containers. Using a clay flowerpot of any size, fill to within 1-inch of the top with a thermite mixture of 3 parts iron oxide ($Fe0^2$) and 2 parts aluminum powder (AL). These proportions are by volume. A paper or cardboard tube (the size of the hole in the flowerpot) should be placed in the hole of the flowerpot and extend to the top of the pot. This tube should be filled with a first-fire mix after the hole at the bottom has been taped. A clay, mud, or plaster cap should be poured or molded over the thermite to the top of the pot. After a fuze or acid delay has been affixed to the top end of the tube and first-fire mix the device is ready to be emplaced on target.

A spark from the fuze or the acid ignites the first-fire mix which in turn ignites the thermite. As the thermite burns, the mud cap contains most of the molten mass inside the pot and allows it to run out the hole at the bottom of the pot onto the target. This molten mix burns at between 4000 and 5000 degrees Fahrenheit which is sufficient heat to weld machinery or motors together or render them useless; also sufficient heat to burn through POL containers and ignite the petroleum product inside.

7. Molded incendiary: An improvised incendiary that has burning properties very similar to thermite can be readily produced from castable materials. With the simplest of equipment, the material can be molded into various common objects such as ashtrays, bookends, busts, small figurines, and bricks. The materials used are relatively easy to obtain, and no special skills are required of the operator to be able to prepare the molded incendiaries.

a. More than one formula can be used, but the one that follows is by far the simplest: 3 parts of aluminum powder, 5 parts of plaster of Paris, and 4 parts cold water, all by volume. As the aluminum powder has the greatest influence on the performance of the finished incendiary, it is necessary to keep close to the specified size, which is grained or atomized powder of 100 mesh or finer. The mixing process is as follows: The plaster of Paris is placed in a suitable container, such as an enamel pan, and the aluminum powder is added. They are then thoroughly mixed together by stirring. All the cold water is then added and the mixture stirred until completely mixed. When this is complete, the material will start to harden immediately. The material is poured slowly into the mold until it is within about an inch of the top of the mold. It should then be agitated for about 5 minutes with a small stick to dislodge any trapped air. The remainder of the material can then be added. No attempt should be made to remove the mold from large objects until a half hour has elapsed, or 15 minutes for smaller objects.

CAUTION: Do not use containers which cannot be opened shortly after the mix has begun to harden. Once initial setting takes place, remove the bottoms from tin cans or break glass away from the incendiary when cans or jars are used as molds. As the incendiary sets, tremendous amounts of heat and pressure are developed and must have some means to escape or the mold will explode.

During the molding process, it is necessary to make a well in the incendiary similar to the capwell in a block of TNT. This well is filled with a first-fire mix (when ready for use) and ignited as a booster for the molded incendiary. The molded incendiary burns at approximately 4500 degrees Fahrenheit.

b. It is essential that the cast articles be thoroughly dried before use. From 1 to 2 weeks of air drying seems to be adequate, and is much less trouble than trying to dry the bricks in an oven. A freshly cast article will be dark grey in color, while one that is thoroughly dry will be whitish and somewhat more brittle.

c. To camouflage the finished product, it can be painted or colored to match the item it was modeled after. In the case of incendiary bricks, brown or red iron oxide may be added during the mixing process to give the incendiary the appearance of different style bricks. As a starting point, add 6½ parts of iron oxide (by volume) to the initial mix.

8. Soap Dish: An excellent charge for both rupturing and igniting the contents of volatile fuel containers is the soap dish which must be placed directly on the target. Using a standard GI soap dish, containers up to 100-gallons can be reliably attacked. Charge proportions are as follows: Equal parts by volume of plastic explosive and thermite mix are placed in the container to be used, always insuring that the incendiary mix is placed against the target. The mix can be composed of a number of compounds, among which are: 3 parts potassium chlorate and 2 parts of sugar, or 2 parts aluminum powder to 3 parts of feric oxide. In lieu of

these improvised incendiary mixes, the contents from thermite grenades can be used. Or military dynamite may be used as the explosive, and matchheads as the incendiary. As a rule of tumb, a thin cigar box, (from an inch and a half to an inch and three-quarters thick) loaded as specified above with one-half incendiary mix, will reliably rupture and ignite volatile fuel containers of up to 1,000-gallon capacity. A charge of approximately twice that size will successfully attack containers of up to 5,000-gallon capacity. Always insure that they are placed below the level of the fuel in the container. This charge may be primed either electrically, non-electrically, or with any type of delay detonator as long as the explosive side of the charge is primed.

Not only is this an excellent charge for destroying POL storage tanks, but is also excellent on gasoline tanks of automobiles and airplanes.

H+ 50 to 1H

BREAK

COMMENT

1H to 1H+ 50

9. Pipe Bomb: A pipe bomb can be made from a piece of iron pipe. The filler can be improvised explosives or improvised propellants such as black powder, thermite, matchheads, or powder from shotgun shells and small arms ammunition.

The size of the bomb depends on the material available. A length of pipe threaded on both ends and 2 pipe caps are used for the body of the bomb. If the caps cannot be obtained, the ends of the pipe are flattened or mashed together to close off the open ends of the pipe. Fill the pipe with one of the above mentioned charges then drill a hole through one of the caps before placing it on the pipe. This hole should be just large enough to permit the passage of a length of time fuze. Insert the time fuze into the charge then slide the cap over the time fuze and screw it onto the pipe. Check to be sure there is no filler material on the threads of the pipe or the cap. Tighten the cap securely.

The pipe bomb is now complete. Notice that this charge requires no blasting cap. To use you only have to ignite the fuze and throw or leave in place.

10. Satchel Charge: Satchel charges can be made in a can or box using ammonium nitrate fertilizer (33 1/3 per cent nitrogen content) and wax. To make this charge melt ordinary paraffin and stir in the fertilizer pellets, insuring that the wax is thoroughly mixed with the fertilizer while still hot. Before the mixture hardens, add a one-half pound block of TNT, or its equivalent, as a primer. The addition of suitable shrapnel material and a handle to the exterior of the charge, makes an excellent expedient satchel charge that is not easily affected by moisture. In fact, this charge can be stored for extended periods without regard to humidity and without loss of effectiveness.

FIRING DEVICES:

1. Standard Firing Devices and Detonators.

a. M10 Universal High Explosive Destructor--is a high explosive device initiated by means of blasting caps or mine activators with standard firing devices. The destructor has booster cups containing tetryl pellets. The chief function of the destructor is in the conversion of loaded projectiles and bombs to improvised demolition charges and in the destruction of abandoned ammunition.

b. M1 Delay Firing Device--commonly known as a "time pencil" this device has a time delay ranging from 3 minutes to 23 days, depending on the model and the prevailing temperatures. As the time delay interval may not be exact, the M1 should not be used if accurate timeing is demanded. The M1 delay type of firing device consists of a tube containing a percussion cap, a springloaded strike, held cocked by a retaining wire, and a glass ampule filled with a corrosive solution. Threads on the base of the tube fit the threads on standard cap wells. A hole through the tube permits inspection to see whether or not the striker has been released prematurely. When the ampule is crushed, the corrosive solution dissolves a portion of the retaining wire, releasing the striker. A colored identification and safety strip fits through the sides of the tube and prevents premature firing. A table is included in each box with the firing devices which gives the delay time for fuzes of each color at different temperatures.

The M1 firing device is prepared for use as follows:

(1) Select a firing device with safety strip of tab color giving the proper time delay.

(2) Insert a nail through the inspection hole or by visual inspection make certain that the striker has not been released.

(3) Crimp a non-electric military blasting cap to the base of the firing device.

c. M1 Pull device-- is designed for actuation only by a pull on a trip-wire and intended for use with improvised antipersonnel weapons or mines, for booby trapping of antitank mines, and for setting up booby traps.

A direct pull of 3-to 8-pounds on the trip-wire causes the device to fire. A non-electric blasting cap must be crimped to the device. The M1 Pull Device has the standard base to fit all explosives and mines fitted with the threaded cap well. When installing the device always remove the positive safety pin last.

d. M1A1 Pressure Device-- is designed for actuation by pressure and intended for use in setting up booby traps.

A pressure of 20-pounds on the pressure cap causes the device to fire. A non-electric blasting cap must be crimped to the device. The M1A1 Pressure Device has the standard base to fit all explosives and mines fitted with the threaded capwell. When installing the device always remove the positive safety pin last.

e. M5 Pressure-Release Device--may be used to booby trap antitank mines equipped with secondary fuze wells and for general booby trap installations with charges having a threaded well.

When restraining load of at least 5-pounds is displaced more than five-eights of an inch, the release plate releases the firing pin

causing the device to fire. A non-electric blasting cap must be crimped to the device. When installing slip a nail or length of strong wire through interceptor holes. With sufficient weight on the device, remove the safety pin gently by pulling the attached cord. The pin should come out easily, then remove the nail or wire from the interceptor holes.

f. M3 Combination Device--this device may be used advantageously in a booby trap when use of a trip-wire, having both pull and tension-release firing actions, is desired.

With pull of 6-to-10 pounds on trip-wire, the release-pin assembly is pulled out until shoulder of striker passes constriction in barrel. Thus released, the four jaws of striker spring open and the release pin pulls out of striker. Jaws of striker then spring back together enabling end of striker to pass through constriction. Released striker, driven by its spring, sets off the percussion cap.

Release of tension, such as detaching wire or cord at anchor end or cutting of trip-wire, permits release-pin assembly to move forward under influence of striker spring until striker clears the construction in barrel and release-pin is stopped by head of firing device. As spring continues to force striker forward its four jaws are spread and pulled free of release-pin knob. Released striker, driven by striker spring, sets off the percussion cap.

A non-electric blasting cap must be crimped to this device. The charge and the trip-wire stakes must be anchored sufficiently to withstand a pull of at least 20-pounds. Insert cap in charge or, if detonating cord is used, tape one end of cord to cap and run other end to charge. Anchor booby trap or firing device firmly with anchor cord. Attach loose end of trip-wire so that it will not slip, using hole in winch spindle. Draw up trip-wire. Take up remaining slack by winding it on winch until locking safety pin is pulled into wide portion of its hole. Remove small cotter key from locking safety pin, and gently withdraw locking safety pin. If pin does not slide out easily, adjust winch winding. Using attached cord, pull out positive safety pin slowly and carefully. This pin should fall out easily. If it resists a gentle pull, replace locking safety pin, remove trip-wire by pressing down knurled knob and stripping off wire, remove base, and check mechanism. Discard defective firing device.

g. Eight- and Fifteen-Second Delay Detonators--time delay varies with temperature changes and accurate timing is not possible. Changes may vary from minus 1 to plus 4-seconds from established standards.

(1) Fifteen-second Delay Detonator: This detonator may be used with any booby trap explosive charge having a threaded capwell, whenever a delay of approximately 15-seconds is desired. It consists of a pull-type fuze lighter, a 15-second length of fuze, and a blasting cap. It is water resistant and may be fired under water. A cap protector fits over the cap for protection during transit. Used in a booby trap, this delay detonator requires a pull on the pull-ring similar to that obtained by use of a trip-wire. The charge must be secured in place.

(2) Eight-second Delay Detonator: This device is constructed like the one just described except that it is shorter and contains a shorter length of time fuze to cut delay down to approximately 8-seconds. Also, the pull-wire has a wire T-shaped handle

instead of a pull-ring. Method of use with booby traps is the same as that described for the 15-second delay detonator.

2. IMPROVISED FIRING DEVICES.

a. Open Loop Device: Used to booby trap trails, equipment, and as a warning device. The open loop is formed by taking two insulated wires and stripping the insulation from the ends of these wires. One end of both wires are formed in a loop. One wire is passed through the loop in the other wire which allows the sliding of the wire through the loop but will not allow the loops to slide through each other. The other ends of the wires (straight ends) are connected as follows: One is placed as a power source lead, the other is attached to one end of the firing wire. The other firing wire is connected to the other firing source lead. The only break in the circuit is the loops when placed apart resting on the insulated portion of the wire. As the wire is pulled the loops slide down the wire until the loops come together providing the necessary completion of the circuit. This device can be used along trails as a trip wire if positioned ankle-high. Other applications are innumerable and depend on the imagination of the individual. (Demonstrate entire sequence.)

b. Explain and demonstrate the water can, clock, electric screen, and clothespin firing devices.

UNITED STATES ARMY SPECIAL WARFARE SCHOOL

EXPEDIENT DEVICES

LESSON PLAN

1. Good afternoon gentlemen. Welcome back to Coleman Range. In the intervening time since our last class, calculation and placement, we have gotten a long way away from our subject. I know there would be many among you who would be disappointed if any range class failed to start with a bang, and the attention charge that was just detonated down range is designed to forestall any such disappointment. And once again, that charge should serve to remind you throughout the afternoon that we will be working with live demolitions on this range. At Coleman Demo Range, safety is our most important product.

2. At this point I will briefly explain what we will be doing here today, and then explain why we do it. During our last range class you saw not only standard demolitions, but some expedient and advanced techniques. Today you will become familiarized with a variety of incendiary, explosive and delay devices. Some of these items are manufactured, some are improvised, and some are constructed completely of materials locally available. Again the class will be divided into five roughly equal groups that will rotate between five stations out in the firing area where today's material will be explained and demonstrated for you. And once again also, at the conclusion of the "county fair" phase you will see a demonstration of the firing of several of these charges down range, after which you will be invited to examine their results.

3. Now that I have explained what we will be doing, it's important that you know why we do it. If you'll think back to the chart listing the capabilities of the Special Forces demolitionist, you will remember that we said that he has a "Thorough knowledge of homemade explosives, incendiaries and delay devices". The question may arise, "Why bother to learn these things? Is it really necessary or important?" And the answer of course is yes. We do have two important reasons for knowing how to "roll our own". The first and by the far most important is the fact that in a denied area we simply may be cut off from outside sources of supply. That is not to say that the first time we are faced with this situation that we find a mortar and pestle and start to work. In a variety of ways we will attempt to get what we need from one well known local source, the enemy. But when we absolutely cannot get what we need, we have the necessary knowledge and ability to make the items from materials locally available. And that brings me to the second reason that I mentioned a moment ago. Materials locally available do not disclose the national identity of the user. There may quite conceivably be times when we may not want to use US manufactured items, and it takes no great imagination to visualize a few such occasions.

4. Before we break the class down to your stations and begin showing you the many items we have out here today, I will first take a few minutes to discuss 1, the three basic components of any infernal machine, and 2, the desirable characteristics of an incendiary. Before proceeding however, I have two announcements. While anyone who cares to think about the subject at all could easily deduce that sabotage is one of the destructive arts highly prized by Special Forces, we nevertheless do not desire to draw attention to our interest in sabotage. For this reason, todays class is classified CONFIDENTIAL, and you are cautioned against discussing any of the techniques or devices that you will see, regardless of how basic they may be or the fact that they may be explained in detail on an Alfred Hitchcock television program. And this brings me to my second announcement, which is merely a request that notes not be taken here today, the key points that are important will be presented again in the classroom where note taking will present no problems.

5. Arson as a fine art will be dealt with in some detail in your Special Targets class. But since you will see several incendiary devices here today, an understanding of their desirable characteristics is important. Show Chart 2.

DESIRABLE CHARACTERISTICS OF AN INCENDIARY

1. EASILY IGNITED
2. BURN WITH INTENSE HEAT
3. DIFFICULT TO EXTINGUISH
4. LEAVES NO EVIDENCE

(Briefly elaborate on each point, and emphasize that extremely few incendiaries will possess all of these characteristics; most are a compromise)

The important point to remember in all of our work with incendiaries is that arson is an extremely effective tool of sabotage. It permits a maximum amount of destruction with a minimum amount of effort, equipment and risk.

Station # 1. Manufactured Devices. Time pencils, miniature shaped charges, magnetic limpets, coal, brick and other molded incendiaries.

Station # 2. Improvised incendiaries and explosives. Thermite grenades, improvised molded figures, phosphorous and water. Caltass and black powder bomb.

Station # 3. Delay devices. Improvised devices for initiating either fires or explosions. Clock used both non-electrically and electrically. Water, string and candle delays. Acid, balloon and magnifying glass.

Station # 4. US standard firing devices and improvised devices. The six standard firing devices. Clothespin used electrically and non-electrically.

Station # 5. DI, both issue and improvised. Ear muff. Bubble charge. New breaching technique.

After student groups have rotated between the five stations, they withdraw to the safety bunker while the caltass, DI and ear muff charges are detonated.

UNITED STATES ARMY SPECIAL WARFARE SCHOOL

SPECIAL TARGETS

LESSON PLAN

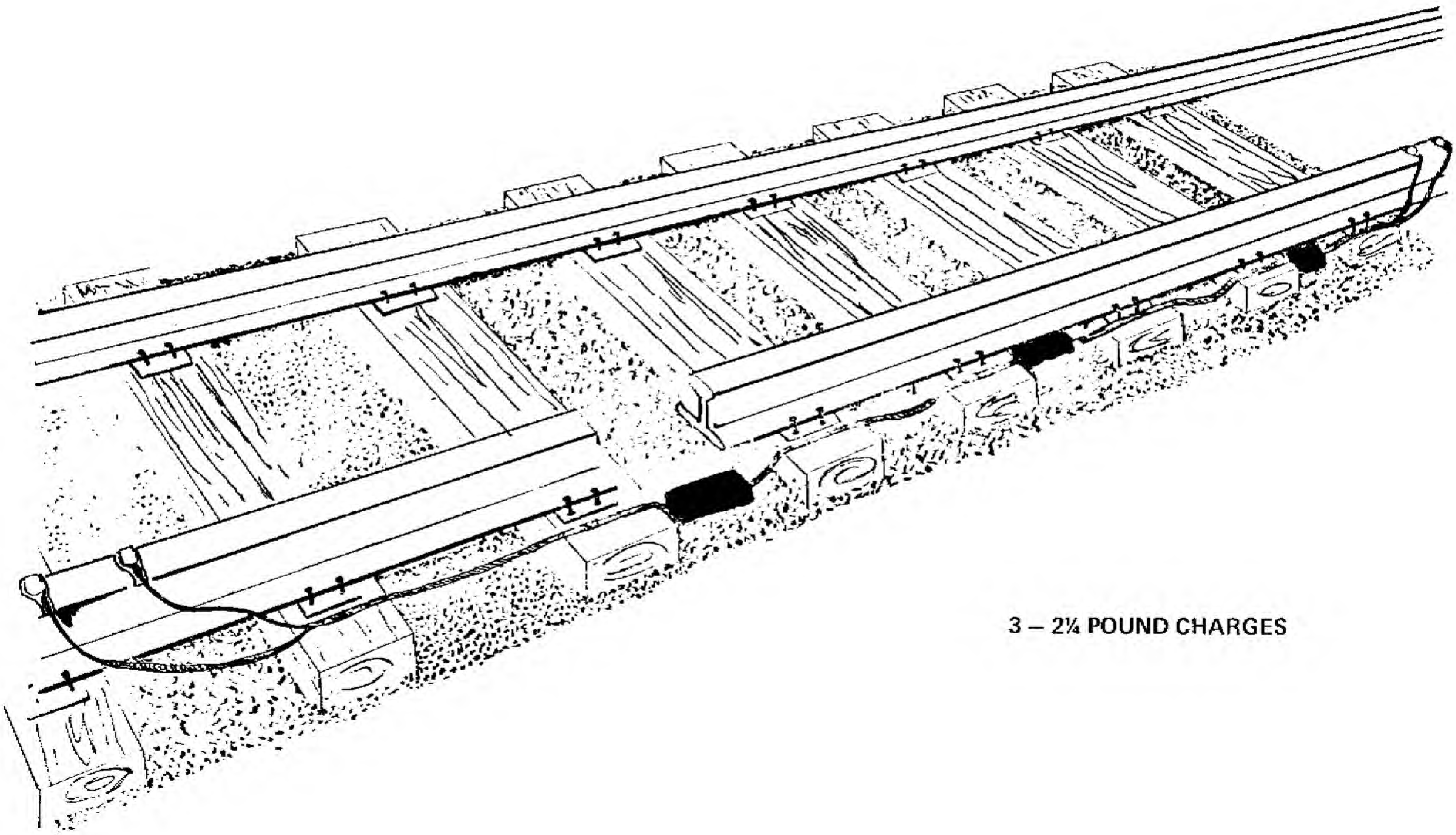
1. CONCEPT. This subject is to familiarize the student with the principles of sabotage, to include target selection, methods, tools, planning and historical examples. Incendiarism and rail interdication are developed and discussed in considerable detail.

2. SCOPE. Principles; operational techniques; industrial targets and recognition; fire for destruction; electrical power plants; transportation systems to include waterways.

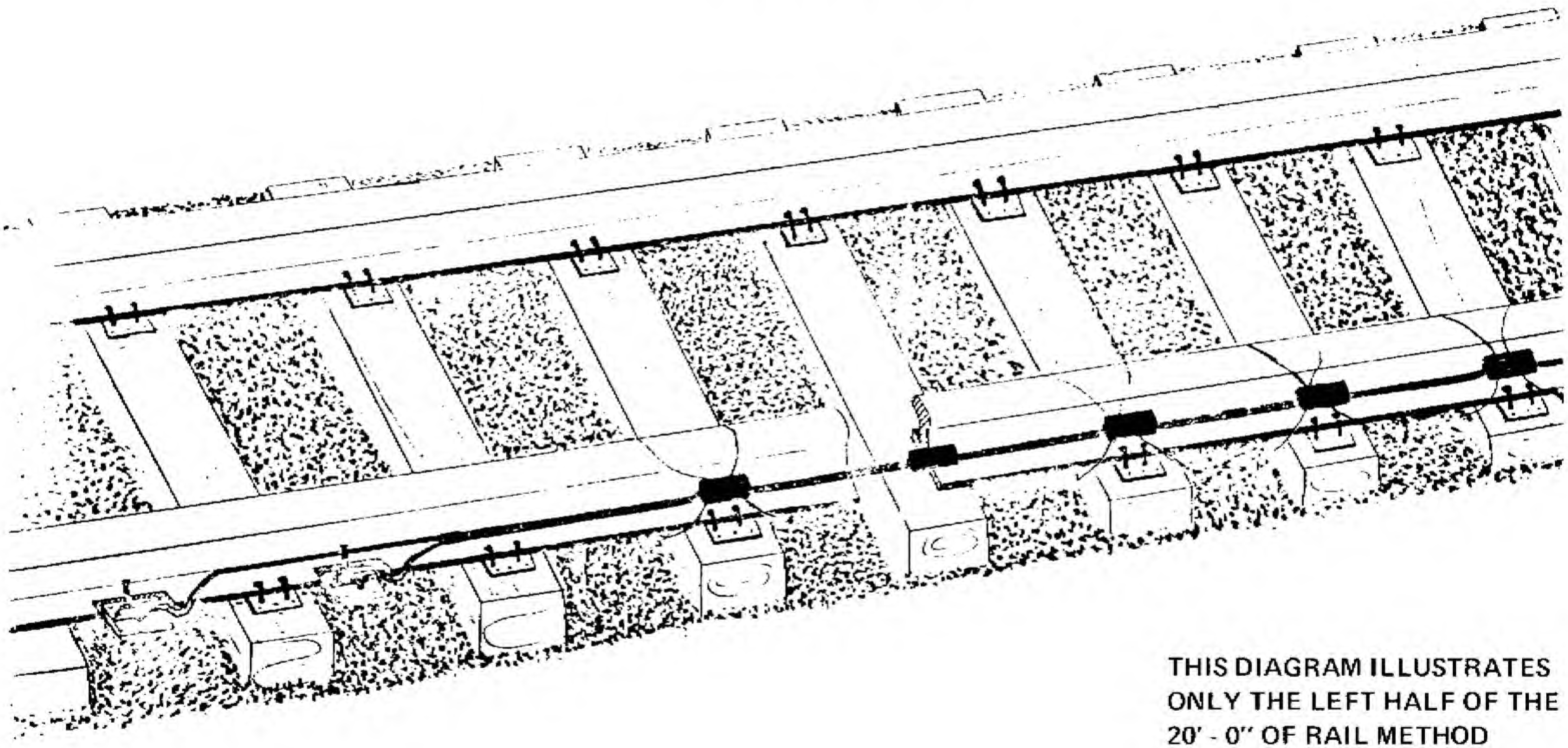
3. REFERENCES: AFM 200-7(C); ORO-T-344 (C); FM 31-20; The Sabotage Manual, Volumes I & II

4. COORDINATION REQUIRED: U3.T7508; U3.T7704; U3.T8001; U3.T7804; U3.T7904; U3.T8104.

1-3-5 RAILROAD CRATERING METHOD



20' - 0" OF RAIL METHOD



THIS DIAGRAM ILLUSTRATES ONLY THE LEFT HALF OF THE 20' - 0" OF RAIL METHOD

10 — 1½ POUND CHARGES

HEADQUARTERS
10TH SPECIAL FORCES GROUP (AIRBRONE)
APO 108 US FORCES

LESSON PLAN

INSTRUCTIONAL UNIT:	Introduction to Arson & Incendiarism
TYPE OF INSTRUCTION:	Conference
TIME ALLOTTED:	
CLASS PRESENTED TO:	
INSTRUCTIONAL AIDS:	None
REFERENCES:	SF 6A 222 USASWS (UW Dept)
STUDY ASSIGNMENT:	Same as References
STUDENT UNIFORM & EQUIPMENT:	Duty w notebook & pencil
TROOP REQUIRMENTS:	None
TRANSPORATION REQUIREMENTS:	None

1. INTRODUCTION:

a. Objective: To give the students a broad, general background of the subject of Arson & Incendiarism as it pertains to sabotage in a SF operational area.

b. Reason: Incendiarism may be the ideal sabotage weapon for a particular mission or target complex.

c. Standard: To make each student conscious of the destructive results of fire; how to insure successful arson, the principles of combustion, associated targets (fire-fighting equipment), etc.

2. EXPLANATION:

a. General: Importance of Incendiarism; Fire is a hazard against which all industries are on guard. Large sums of money are expended each year for preventing, reporting and fighting fires. Fire prevention includes educating employees in fire hazards, making them safety conscious, and inspecting the plant periodically. Included in fire reporting are automatic and hand-operated alarm systems, night watchmen, and sprinkler systems. Fire fighting includes the cost of stationary and movable equipment and the salaries of firemen. Even though so much money and time has been spent, the United States loses about 350 million dollars worth of property and over 10,000 lives in the million and one-half fires reported each year. For example, the Coconut Grove fire in Boston cost about a million dollars in damage and 468 lives. The Bar Harbor, Maine fire cost about one and one-half million dollars. In computing the cost of a fire, one must consider direct loss by burning and damage by smoke, water and fire-fighting equipment. Indirect losses include loss of production, medical expenses of injured employees, and cost of rebuilding the physical plant. Since fire can be devastating and so few tools are needed to start a fire, it is an ideal sabotage weapon. The saboteur can choose the time, the place, and the means to start a fire. In the annual report put out by the International Association of Chiefs of Police for 1951, it was reported that one in eight fires were started by arsonists, yet very few guilty persons are captured. The reason for this is that the guilty person can select the time which seems to him best suited for the commission of the offense,

and the absence of any witnesses. In most arson cases, proof of guilt must be deduced from circumstantial evidence. The conference estimates the loss due to fires started by arsonists to be 70 million dollars a year.

Fire also has a psychological effect on the general public. After a series of fires are reported in a certain industry, ABSENTEEISM throughout that industry is noted.

In summarizing, we can state: Fire is a good sabotage weapon because (a) it is a natural hazard, (b) it may alter or destroy evidence, and (c) it is very destructive.

b. Causes of Fire:

(1) Spontaneous combustion.
(2) Carelessness or accident.
(3) Lightning or electric short circuit.
(4) Chemical reaction.
(5) Defective equipment.
(6) Those started by arsonists or saboteurs.

c. Subtle Arson or Subtle Sabotage:

Sabotage by fire can either be subtle or direct. A saboteur must be familiar with the techniques of each. With this in mind, I have for you an excellent film entitled "Incendiarism." This film is approximately 22 minutes in duration and clearly depicts the major principles involved in employing this type weapon. I should like for you to especially note the recommended placement, techniques of ignition, and the need for a comprehensive plan of action. Upon conclusion of this film, be prepared to discuss these factors.

In subtle sabotage we must make the fire appear as though it were due to natural causes. To do this we may have to sacrifice some of the surefire techniques of the direct method. Subtle sabotage requires very careful planning and operating techniques.

In planning an operation, we must first analyze the plant or target to see where a fire would naturally start. Most industries have areas that are fire hazards. Next, we must start this fire with material that is NATIVE to that section of the plant. This means that we can't bring in material that is not used in that plant or material that is not normally found in that part of the plant. The material that we use to start the fire is called the IGNITER. A good igniter is a material that burns at a high temperature so that it can ignite the target or wick. Matches, cigarettes, electric sparks or other sources of external heat may be used to start a "subtle fire," if we can make them appear to have gotten there from normal use of the area. Certainly a manufactured item could not be used except in cases where we were sure no evidence would be left.

After picking out our igniter we must look at our target and see if the igniter will be sufficient to start it burning. If your target is gasoline or other very inflammable material that is all you may need, but in most cases you will need a material between the igniter and target. This material is called the wick. Its purpose is to hold, increase, and distribute the flame. Wood shavings, rags, newspapers, and oily equipment may be used. The material we choose will depend on the target. To choose a good wick properly, we must know how much heat it takes to get the target burning. This is called the FLASH POINT.* The technical definition of flash point is the temperature at which a substance gives off vapors which can be ignited by a spark or flame. The flash point of a number three fuel oil is 125 degrees.

*The term FLASH POINT is used when dealing with liquid substances.

When dealing with substances other than liquids, such as paper, wood, coal, we classify them as either tinder, kindling or bulk combustibles.

TINDER is the technical name for combustibles with a specific surface of over 20 sq cms per gram. (28 grams is about 1 oz.) A match will ignite tinder. Four different classes are:

(1)	(2)	(3)	(4)
wood shavings	gasoline	celluloid	combustible dusts up to 1000 sq cms per gram
wood chips	bensene	pyroxylin	
sawdust	kerosene,	match-heads	
cotton waste	etc., (hard to ignite)		
oily rags			
dry undergrowth			
loose straw or hay			
crumpled paper			

Note that paper must be crumpled; flat sheets of paper burn only with great difficulty.

KINDLING is the technical name for combustibles which burn like dry wood with a specific surface of over 1.7 sq cms per gram. They are not ignited by a match, but are by the chemical ignitors, and in turn set fire to bulk combustibles. Dry wood shavings or splinters, small pieces of wood with jagged edges, wooden partitions ½-inch or less in thickness, and thin, light furniture can be used as kindling.

BULK COMBUSTIBLES: Combustibles having a surface of less than 1.7 square cms. per gram require burning kindling to ignite them. Wooden structures, wooden floors, bulk coal, baled rubber or cotton, heavy furniture, books, all require prolonged heating.

Once the igniter has ignited the wick and the wick the target, then we must have ventilation, because no fire can burn without a source of oxygen. To get ventilation we should open a window, not to get a draft that will blow out the flame, but to get enough air to insure a sufficient supply of oxygen.

In order to do maximum damage in subtle sabotage it is important that you pick out the right place to start your fire and set it off at a time when it will not likely be discovered until it has reached its FLASH OVER point. This is the point when all the combustible material burst into flame. This term came into use during WWII when they tested incendiary material to determine the length of time it takes from the setting off of an incendiary to the point at which all the material in the room bursts into flame. It is believed that the following takes place: Combustible materials, when heat is applied, are constantly giving off vapors. When these vapors fill the room or reach the spark, they will ignite.

The growth of the fire involves two factors: Convection of heat and radiation of heat. At the beginning of the fire 85 per cent of heat is convected upwards, and 15 per cent of the heat is radiated in all directions. As the wood heats up it reaches a critical temperature (between 300 and 575 degrees c., depending on the bulk incendiary) where the carbon, hydrogen and oxygen materials in the wood or other combustible suddenly form gaseous products (CO); at this instant the bulk combustibles become self-supporting and the fire blazes on. Beyond this point, the fire is out of control.

It may be possible to start your fire by spontaneous combustion. Spontaneous combustion is defined as: heating and ignition involving a combustible material or combination of materials if the inherent characteristics of the materials cause an exothermic (heat producing) chemical action to proceeds, without exposure to external sources of fire, spark or abnormal heat. The process is known as "spontaneous heating," and as "spontaneous ignition" or spontaneous combustion" if ignition occurs.

As an example, a pile of oily rags or a mow of moist hay slowly unites with oxygen of the air (burns). If the heat of the combustion cannot be easily conducted away (the rags and the hay being poor conductors) the pile heats up higher and higher from day to day, until the kindling point of the combustibles is reached. At this point, the rags or hay catch fire. This is called spontaneous combustion. Notice that it is favored by two factors: (a) poor conduction of heat away from the combustibles and (b) a low kindling point. The piles are not able to get rid of the heat which is generated by their oxidation, particularly if they are packed too tightly for air to circulate rapidly through them.

To start a fire in this fashion we might put oily rags on a hot pipe, expose oily rags to the direct rays of the sun, or in the case of grains, disturb the ventilation system. Remember again, it must look like an accident that the ventilation was shut off or not working.

Lloyds Register records over 100 cases of spontaneous combustion each year, 65 per cent of them due to external heating from the boiler room, steam pipes, funnel casing or climatic conditions.

d. Direct Sabotage by Fire:

Direct sabotage by fire may do more damage and be more effective than explosives. A warehouse and its contents may be destroyed by fire that would require hundreds of pounds of explosives. Fire has its limitations and depends many times on chance for maximum effectiveness. As we mentioned before, fire is a natural hazard and hundreds of dollars are spent to prevent and fight it. Also, the enemy is on the alert for attacks of sabotage by fire.

(1) Placement: In picking a place to start a fire, we are interested in finding an area that will enable the fire to spread rapidly and engulf the whole warehouse or target and surrounding area. Our main purpose is not to hide the fact that the plant was sabotaged, but to do maximum damage.

(a) Arranging combustibles to favor convection: An ample supply of air is required for the combustion. Air supply can be increased in two ways: (1) by increasing ventilation and (2) by arranging the combustibles so as to get a "chimney effect," which will be explained below.

1. Increasing ventilation: Open windows and doors: High on the lee side (the side away from the point from which the wind blows) and low on the windward side (the side from which the wind is coming). This supplies a draft for sweeping the fire forwards and upwards. Remember that during the early stages of the fire, too strong draft will hasten the burning of bulk combustibles. If the wind is blowing too strongly, open windows only in an adjacent room.

Closely packed combustibles must be loosened up so that the air can get to them. Baled cotton, rubber, or fabrics, or bundles of paper will not burn until they have been broken up mechanically or by high explosive.

2. Chimney effect: Once a fire starts in an area where combustible materials are plentiful, a column of intense heat begins to arise. This column creates a so-called "chimney effect" in drawing air to the center. Its effect can be increased by building the fire near airshafts, elevator shafts, ducts, conveyors, pipes and stairways leading to upper floors, (but be sure the doors on the upper floors are fastened in an open position). Some ways to favor this chimney effect follows:

a. Vertical surfaces: They will provide chimney effects if one has partitions upright, 2-inches or less apart. Such partitions can be made on the spur of the moment by moving packing boxes close together, tipping a table on edge close to a wall or by swinging a door back on its hinges and starting a fire in the angle between the door and the wall.

b. Horizontal surfaces: They will burn fastest where there are holes cut in the floor (for passage of pipes, conveyors, etc.) which provide draft. Fires started in between partitions of floors may get a considerable start before being discovered. As the hot air sweeps up through holes in the floor from the story below, it is usually sufficiently heated so it would set fire to kindling placed around the hole. (This current of very hot air is a phenomenon dreaded by the fireman, who is often burned to death, with no external signs of its cause, by breathing it in upon opening a door into a room which is on fire.)

c. Attic eaves arrangement: The chimney effect is also obtained with another arrangement, the attic eaves effect, although the chief importance of this arrangement is its reflection of heat, discussed in the next section. Combustibles placed in the angular space where the attic roof meets the floor will reflect heat and ignite very quickly. However, the attic is not an especially good place to start a fire since, although it may go unnoticed for many minutes giving the fire time to gain headway, the fire may not spread to lower floors since heat sweeps upwards. On the other hand, the operator can make an attic eave arrangement in other parts of the house, as for example beneath the stairway leading up from the ground floor. If kindling is ignited here, the fire will spread quickly up the stairway, spreading to both the ground floor and second floor simultaneously. Similar arrangements can be achieved by starting a fire in the corner of a closet with the closet door open, or by leaning doors or boards against the wall and starting a fire beneath them.

d. Arranging combustibles to favor radiation: As the fire progresses, the spread of heat by radiation processes becomes increasingly important. Radiation is favored by the three items just discussed: Parallel vertical walls, parallel horizontal walls, and attic eaves arrangement. The reflection of heat from these surfaces is called a "baffle effect" and is of greatest importance in starting fires quickly.

Generally a fire should be started on the bottom floor since heat rises and would set fire to the upper floors as the fire progresses. But if the upper floors contain inflammable liquids of rubber, it might be better to start the fire there, forming burning liquids which would run down and ignite combustibles on lower floors. Or the dry, wooden roof on a shed might be ignited, if it would drop down and set fire to stores on the ground below.

It is well to start a number of fires at the same time so that they mutually assist each other, and spread the fire rapidly in all the area. This is far better than trying to start one large fire in the area.

Choose the site of the initial fire in relation to the whole target: near the woodworking shop, the paint stores, the packing room, oily wastes; in other words, in the most inflammable portion of the factory, provided that section is not protected against spread of fire from it to the rest of the plant.

(b) Factors to avoid:

1. Painted surfaces: These burn poorly. This may surprise you when you recall how inflammable a paint may be. But a lacquer or paint is inflammable because of the oils and solvents in it, and these evaporate or change during the drying process and their inflammability ceases. Unpainted surfaces are always preferable; and if a baffle is being made with a painted chest of drawers pushed against the wall, face the unpainted back of the bureau against an unpainted wall, or use the unpainted bottoms of the drawers.

2. Wallpapered surfaces: These burn poorly since dry paste is not especially inflammable.

3. Wet wood: Before the wood will burn the moisture must be expelled and this uses up heat, slows the rapid spread of the fire. For this reason, do not attempt to set fire to a lumber yard or other outdoor stores a few days after a rain spell.

4. Charred wood: The burned wood or charcoal does not ignite very readily unless it is heated quite hot.

(2) Techniques of starting the fire:

(a) Analyze the plant for the ideal place to start the fire. Also consider the value of starting more than one fire.

(b) Knowing the target, decide what you are going to use for an igniter. Here we don't care if it is native to the target or not. What we are interested in is getting a good fire started. The Agency has a few manufactured items such as the PTI, which I will go into in detail a little later. The igniter may be activated by mechanical, electrical or chemical means. Examples of these means are: mechanical - booby trap and clock; electrical - a switch, short circuit; chemical - time pencil, two incompatible acids, and acid and sugar chlorate mixture, etc. During this course we will handle a great many items that can be used here. A igniter generally gives you a time delay.

(c) Use of a wick to hold, increase and distribute the flame. We may use paper, wood shavings, oily rags, etc.

(d) Accelerant should be used when material has a relatively high flash point or if you want to get the fire to the flash over stage faster.

(e) After having a fire going, we want to be sure there is trouble putting it out, so we neutralize fire fighting equipment. It may be possible to carry out this part of the operation before being discovered by the watchman. Attack the fire fighting equipment which is nearest to the point of the intended fire. Some points of attack follow:

1. Hydrants: Shut off, smash or jam the valves. Or shut the main valve and secure it with lock and chain.

2. Hose: Slash this with a sharp knife. Or put a few drops of concentrated sulfuric or nitric acid a number of places on the hose, in positions where it will not normally be detected, a day before the attack. The acid will etch weak spots in the hose which will fail under water pressure.

3. Nozzles: Throw these away or damage.

4. Fire-doors: These usually have a link of fusible alloy (melts about 68 degrees C.). Reinforce with a stout wire. Place a brick on the floor, or a wedge, to keep the firedoor from closing. Immobilize the firedoors on the upper floors so that the fire will be free to sweep upwards. Or lock these doors in an open position and throw the keys away.

5. Fire alarm: Disconnect all electrical alarm systems.

6. Automatic sprinklers: Place high explosives in several places on the sprinkler system.

7. Fire extinguishers: The bicarbonate-sulfuric acid type of extinguisher can be unscrewed at the top, and the acid bottle removed and thrown away. Or the contents of the extinguishers can be emptied. Pump extinguishers (such as the carbon tetrachloride type) can be emptied and then filled with gasoline. Buckets of sand or of water can be filled with gasoline, although the latter should be done immediately before starting the fire, since the odor of gasoline might alert the enemy to the intended attack.

(f) Placing bombs: To discourage fire fighters, the operators should place a number of hand grenades with their levers tied down with cord; when the cord burns, the grenades explode. Or any of a number of bombs activated by booby-traps set off by the fire fighters can be employed. Place fog or smoke bombs up-wind of the fire so as to make approach difficult.

(g) Overpowering the guards: The operators should know where the watchmen are on patrol, and assign men to overpower the guards while the other operators are neutralizing the fire fighting equipment and placing nuisance bombs.

Since there are so many points to consider in starting a fire, it is imperative that a detailed plan be made. All equipment should be tested on a similar target.

e. Methods of Dealing With Certain Targets:

(1) Oil stores: It is necessary to release the oil from its container by blowing a hole with an explosive charge, opening a valve or otherwise.

If the material is then allowed to spread, it not only would be much easier to ignite, but will spread the flame to adjoining tanks. Gasoline, kerosene, and alcohol can be ignited by any delay action device. Gasoline can often be fired within storage tanks by an explosive charge placed in contact with the container plate, but to insure fire mix magnesium and aluminum with the explosive. Diesel oil, fuel oil and lubricating oils require heating before ignition takes place. This can be accomplished by pouring gasoline or kerosene over the more viscous petroleum. For example, the explosion resulting from a small charge placed in contact with a small gasoline can would scatter the flaming contents over a wide area; alternatively, a large incendiary parcel would be employed.

Kerosene is superior to gasoline for general incendiary purposes. It evaporates at a slower rate, hence it burns longer.

(2) Pitch and tar stocks: If stored in wells, use an incendiary parcel. Float it on the surface of the tar, on a piece of wood if necessary. If the tar is stored in tanks, use an incendiary parcel linked with an explosive charge. Once the material is heated to the necessary temperature ignition takes place. The burning is intense and is accompanied by dense smoke.

(3) Paint stores: The contents of a drum of paint or a few cans could be poured on the floor and then set ablaze with an incendiary. If this is impossible, the incendiary in conjunction with a small breaking charge should be used. Where paint is stored on wooden shelves, it will usually be sufficient to set fire to the shelves; for best results feed the flame with paint.

(4) Paper stocks: Open and spread out as many packages as possible. A considerable amount of kindling material will be required to get a large stock afire. Small explosive charges placed among packages, rolls, etc., will help considerably to spread the fire. Paper in bales, rolls, etc., is not likely to burn completely.

(5) Rubber stores and processing plants: Start the fire among raw material stores, providing these form a part of the main building. If the rubber is in compressed bales, split one open and add as much kindling as possible. Semi-processed rubber is often stored on wooden shelves and this may be a good point at which to start a fire. Rubber is difficult to ignite and an incendiary of long duration is required. Sponge rubber crumpled up is very inflammable.

(6) Textile factories: The most damaging attack can probably be made on the carding machines, as there shops contain large quantities of gossamer and loose fiber on the machines. Stacks and bales of partly processed material in loose condition are another place where a fire can be started. The fire should be built in the center of a heap of this material with a thermite or magnesium incendiary.

(7) Flour mills: Flour mills contain a considerable amount of light, dry timber, which is used for enclosing the conveyors, elevators, chutes, etc. Long burning incendiaries such as magnesium should be placed at a well ventilated vertical surface. Grain itself burns well once the fire is well started, and with free access of air soon becomes very difficult to extinguish. Gasoline and kerosene may be used to initiate the fire.

(8) Sugar refineries: Crystallized sugar would be an ideal target for incendiary attack. This may be initiated by means of thermite or magnesium incendiaries. Several containers should be opened, the contents spread around.

f. Sabotage by Water:

When small fires take place in certain industries considerably more damage is caused by the water used for extinguishing than by the fire.

A small fire in a workshop, store, or office, started by "accident" during working hours, could be extinguished immediately by an excessive amount of water, thus creating great damage.

This form of attack will be most effective where delicate machine tools and precision instrument and finished steel parts are to be found; examples: woodworking plants, bearing factories, warehouses, textile mills, grain elevators, all forms of documents. Machinery attacked by water must be dismantled in order that rust may be removed.

Sprinkler systems are widely used in most countries as a means of extinguishing fires at their source, in factories, stores, warehouses, or wherever inflammable goods are in process of fabrication or storage.

They function automatically on rise of temperature above a predetermined limit (usually 155 degrees F.) by the fusion of a special soldering alloy or the bursting of a glass tube, thereby releasing a valve seating and allowing a jet of water to issue from the pressure pipe system. This jet of water impinges on a small circular deflector which creates a spray over the area below the sprinkler.

The release of water from a sprinkler actuates an alarm. If steps are taken to prevent the alarm from functioning, and if/ number of sprinkler heads are actuated, a large quantity of water will be released silently; serious flooding should occur before the attack is discovered.

The Wet Pipe System is installed where there is no danger of freezing; the piping is filled with water under pressure.

The Dry Pipe Assembly is used where freezing is likely to occur; i.e., Russia, Finland, Sweden, etc. Here the pipes are charged with air at a pressure high enough to keep the valve in place. On the opening of the sprinkler head, the reduced air pressure is overcome by water pressure which opens the valve and permits the piping to fill with water.

All sprinkler systems are provided with a main stop valve which is accessible at ground level. Large buildings have miltiple circuits, each controlled by it own valve.

The handwheel of the stop valve is fixed in the wide open position by means of a strap or chain. It is turned off if emergency arises; i.e., if sprinkler functions accidentally.

Attack: See that main stop valve is in normal position. Close alarm clock by turning quarter turn clockwise direction. This shuts off water to the alarm motor. Treat every circuit in the same manner.

To attack individual sprinkler heads: Use time pencil and match material to effect fusion of soldering alloy or to burst glass tube. To counteract the device: Cut the strap or chain on the main stop valve; close the valve; replace chain with padlock. Saw the threaded valve shaft off.

HEADQUARTERS
10TH SPECIAL FORCES GROUP AIRBORNE
APO 108 US FORCES

LESSON PLAN

INSTRUCTIONAL UNIT:	Field Expedient Detonator or Blasting Cap
TYPE OF INSTRUCTION:	Demonstration
TIME ALLOTTED:	
CLASS PRESENTED TO:	
INSTRUCTIONAL AIDS:	See attached tng aids list Train-
REFERENCES:	ing Memorandum 5 Hqs 10th SFG, dtd 27 Feb 62, Annex D, Destructive Techniques
STUDY ASSIGNMENTS:	Same as reference
STUDENT UNIFORM AND EQUIPMENT	Duty w crimpers, knife, friction tape, pencil & notebook.
TROOP REQUIREMENTS:	None
TRANSPORTATION:	None

1. INTRODUCTION

a. Objective: To demonstrate field expedient detonators or blasting caps to include construction and methods of detonation.

b. Reason: Demolition specialists must know how to make and use expedient detonators. One may not always have manufactured blasting caps to fulfill the mission.

c. Standards: To have all demolitionists capable of both teaching construction, theory and employment of field expedient detonators, as well as being able to perform an operation mission, employing expedient detonators when necessary.

2. EXPLANATION AND DEMONSTRATION

a. Construction:

(1) Remove projectile and powder (propellant) from a rifle cartridge and discard them.

(2) Remove enough PETN from some detonating cord to almost completely fill the empty cartridge case.

(3) Pour the PETN into the cartridge case to within about ½ cm from the neck and insert the detonating cord which leads to the charges. Crimp the cartridge case to the detonating cord, and tape it at this junction, or waterproof it if underwater use is anticipated.

b. Methods of Detonation:

(1) First Method: Tape a cardboard sleeve, larger than the largest diameter of the cartridge case to the case about half-way down its length, and fill this container with an acceptable first fire mix. Insert time fuze into this container from the opposite end, until the time fuze is within about 1 cm from the base of the cartridge. Seal the container to the time fuze, again waterproofing (if required) as in step 3 above. The number of charges that may be fired using this detonator is limited only by the amount of detonating cord that is available.

(2) Second Method: Run the free end of the detonation cord down a rifle barrel until there is no slack, and then chamber the cartridge. Connect branch lines to the main line which emanates from the barrel to all charges. Secure the weapon in place, and tie a piece of rope, wire, or string to the trigger. This cord should be no less than 20 meters in length if the operator is unprotected. Fire the weapon by means of the cord. This method destroys the weapon, but it also will detonate the charges.

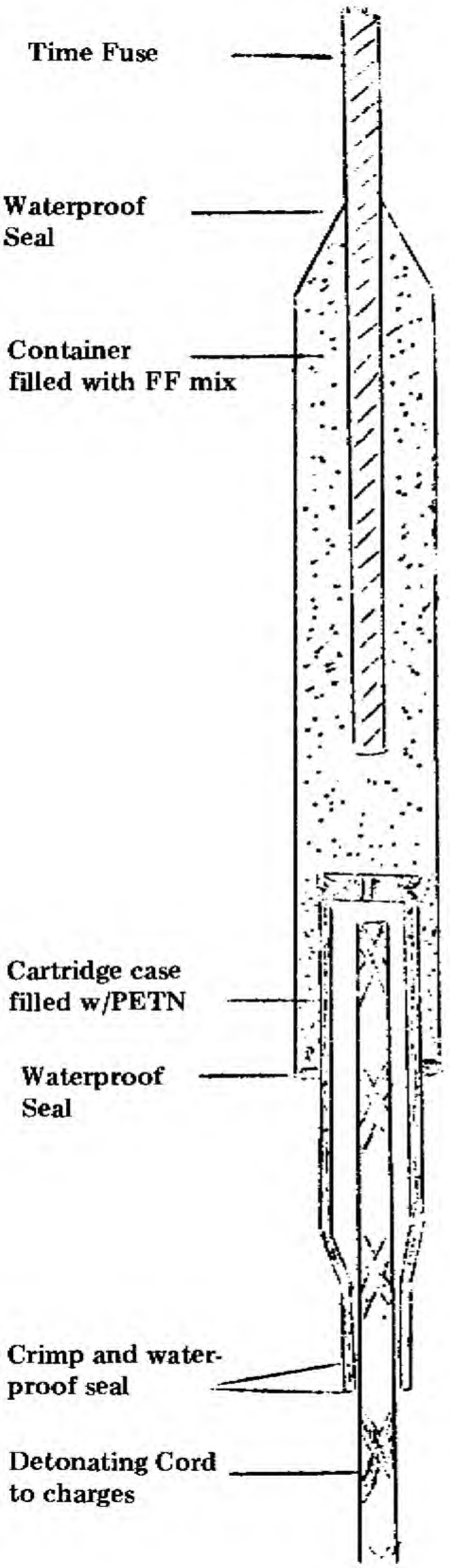
(3) Third Method: Mold a piece of plastic explosive around the base of the cartridge, until you have 2 cm around the case. Light the plastic, and seek cover. When the percussion cap is detonated by the heat, the PETN will be detonated, which in turn will fire any charges attached to the detonating cord.

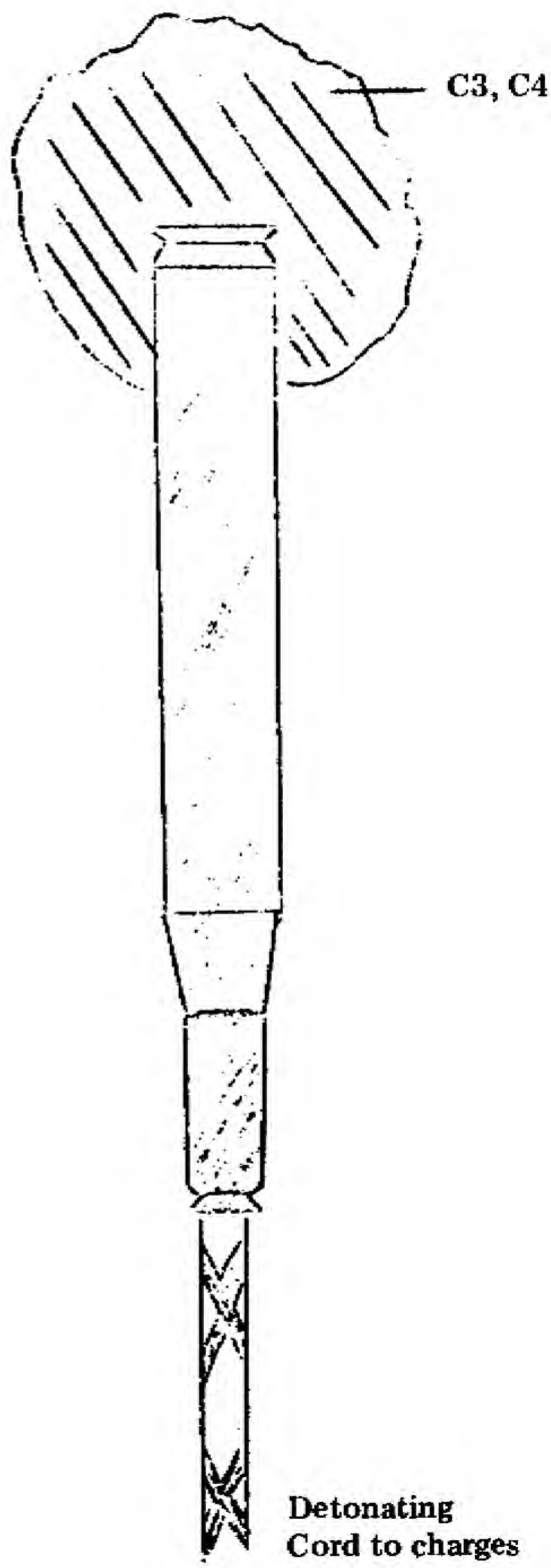
3. PRACTICAL WORK

Form students into working groups of 3 or 4 men. Provide necessary explosives with components, tape, etc. Direct each group to construct and detonate at least one detonator. Insure that personnel take cover during firing.

TRAINING AIDS LIST

Blackboard
Chalk
Crimpers
Friction Tape
Knife
Detonating Cord
Plastic Explosive
Expendable Rifle and Cartridges
Cardboard Tubes
Pliers
Waterproofing Compound
Twine
First Fire Mixture


Time Fuse
Waterproof Seal
Container filled with FF mix
Cartridge case filled w/PETN
Waterproof Seal
Crimp and water-proof seal
Detonating Cord to charges


C3, C4
Detonating Cord to charges

UNITED STATES ARMY SPECIAL WARFARE SCHOOL

ADVANCED DEMOLITION TECHNIQUES AND SPECIAL DEVICES

ADVANCE SHEET

PURPOSE

The purpose of this subject is to provide you with a working knowledge of constructing and emplacing advanced technique charges, and to familiarize you with issued and expedient firing devices, improvised incendiaries, and an introduction to new devices and developments and future contingency plans.

HOMEWORK ASSIGNMENT

1. Study advanced technique charges covered on Demolition Card, GTA 5-10-9.

2. Review material covered during the fourth hour of 756 and all material in 750.

BRIEF

During this instruction each student will be required to perform practical work in construction of at least one of the advanced technique charges. A walk-around will be conducted to enable each student to view each of the advanced technique charges emplaced on target. Afterwards, a demonstration firing and viewing of the effects will be conducted. A demonstration of issued and expedient firing devices will be shown. Mixing and employing of improvised incendiaries will be demonstrated. A demonstration of new developments and devices will be shown and future contingency plans will be discussed.

UNITED STATES ARMY SPECIAL WARFARE SCHOOL

ADVANCED DEMOLITION TECHNIQUES AND SPECIAL DEVICES

SECTION I

SUMMARY

Special Charges

1. The primary advantages of advance technique charges are that they invariably require less explosive; they achieve results that are more positive than those produced by conventional charges; and tamping is not required.

2. The primary disadvantages of the advanced technique charges are that they usually require a great deal of time to construct; once constructed, they are usually more fragile than conventional charges. All of the charges should be wrapped or packaged but excessive wrapping material between charge and target must not exist. Most of the charges require C-4 or C-3 explosive, which is a limiting factor, as it may not always be available in the field.

3. SADDLE CHARGE: The saddle charge is used to cut cylindrical, mild steel targets up to 8-inches in diameter. Dimensions of the charge are as follows (refer to figure 1): Short base of the target is equal to half the circumference of the target. The height or long axis of the charge is equal to the circumference of the target. The thickness of the charge is one-third the thickness of a block of C-3 or C-4 for targets up to 6-inches in diameter. Thickness of the charge will be one-half the thickness of a block of C-4 or C-3 for targets from 6- inches to 8- inches in diameter. Prime the charge at the apex of the triangle. On detonation, the target will be cut directly under the short base.

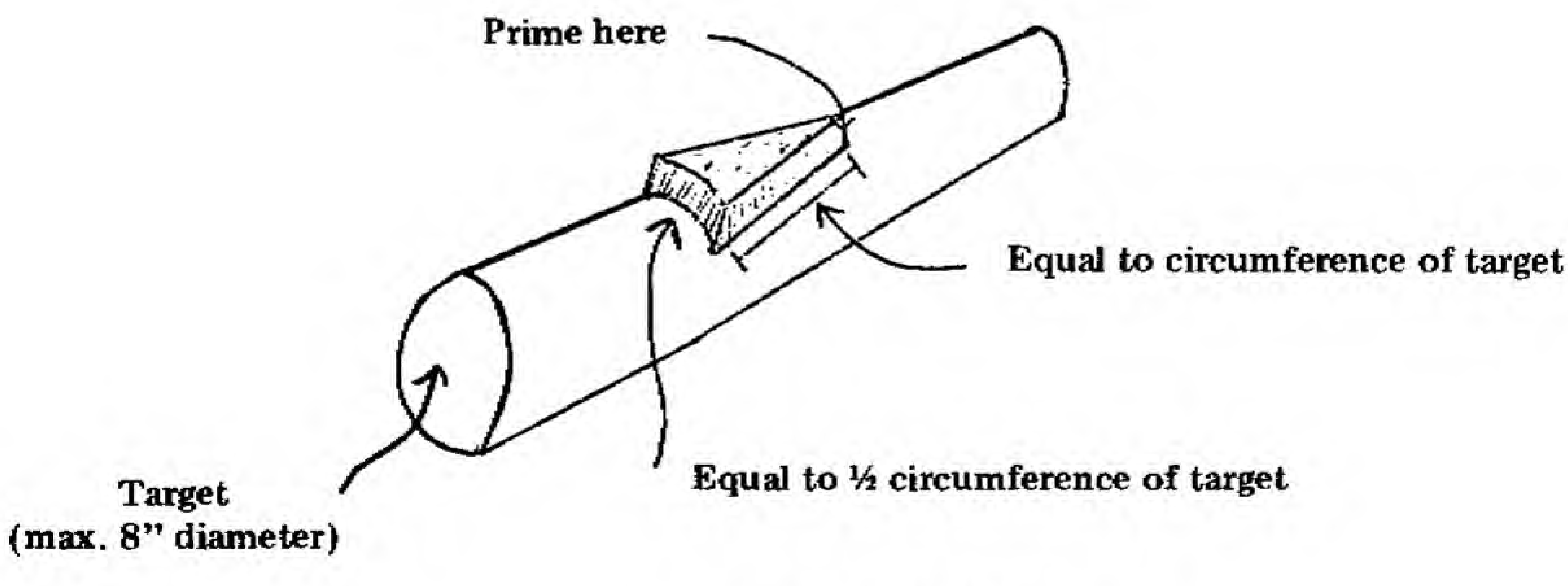


Figure 1. Saddle Charge

Do not use saddle charge on targets of non-solid construction (gun barrels), steel alloys, or targets measuring greater than 8'' in diamter.

4. DIAMOND CHARGE: The diamond charge is used to cut either mild or alloy steel cylindrical targets of any size that would conceivably be encountered. (For instance this charge was used to cut a propeller shaft of a destroyer that measured 17" in diameter.) Dimensions (figure 2) are as follows: The long axis of the charge must be equal to the circumference of the target. The short axis must be one-half the circumference of the target. The thickness of the charge will always be one-third the thickness of a block of C-3 or C-4. To prime the charge, both points of the short axis must be primed for simultaneous detonation.

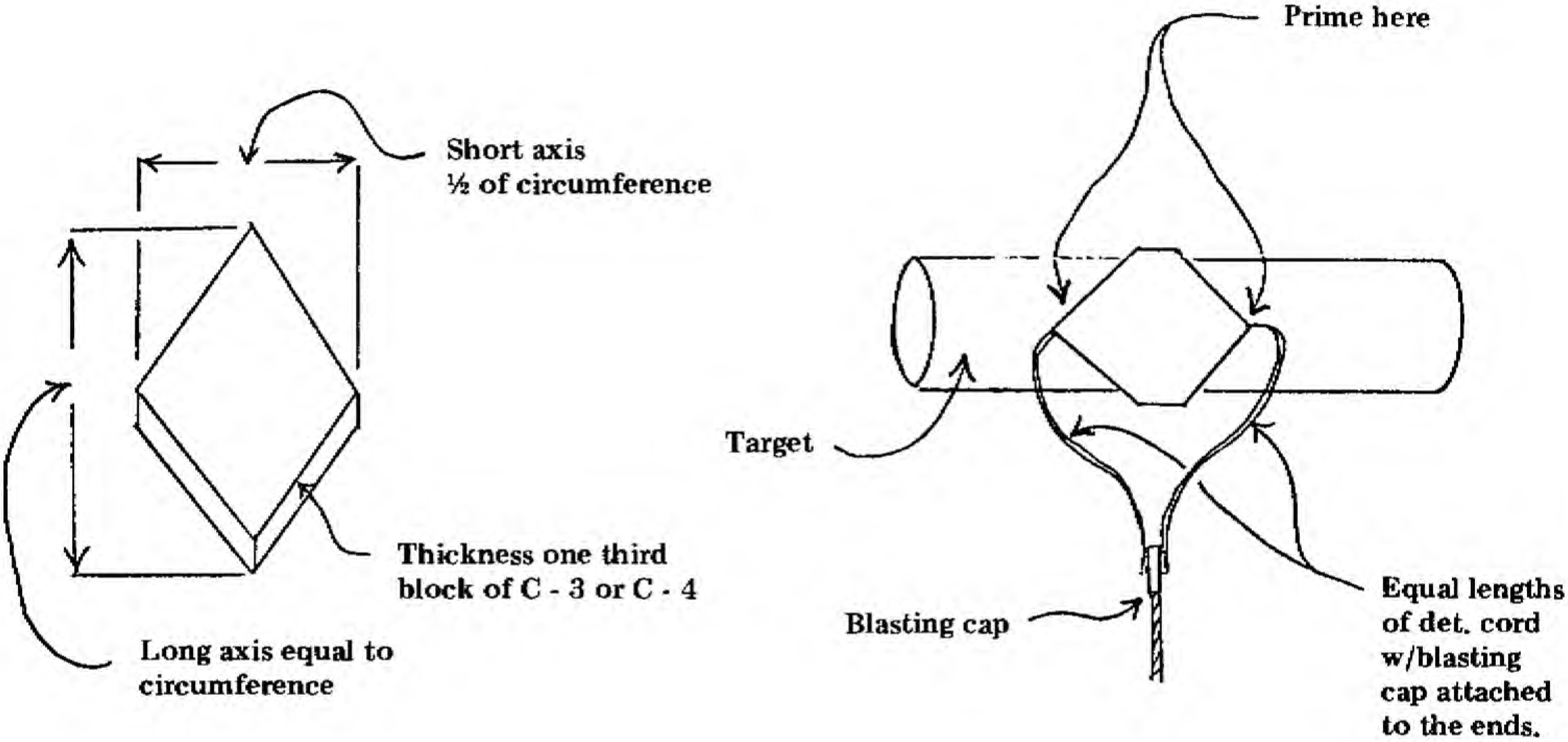


Figure 2. Diamond Charge

The diamond charge may be primed with a detonator assembly as shown in figure 2 or may be primed with two electric blasting caps wired in a common series circuit for simultaneous detonation.

5. RIBBON CHARGE: The ribbon charge is used to cut non-cylindrical steel targets, i.e., "I" beams, angle irons, etc., up to 2-inches thick. Excellent results are produced with a considerable savings of explosives. The dimensions (figure 3) of the charge are as follows: Thickness of the charge is equal to the thickness of the target but never less than ½-inch. Width of the charge is twice the thickness of the target. Length of the charge is equal to the length of the desired cut. Prime the charge from either end. Build up the corners of the charge if it is designed to cut such items as "I" beams.

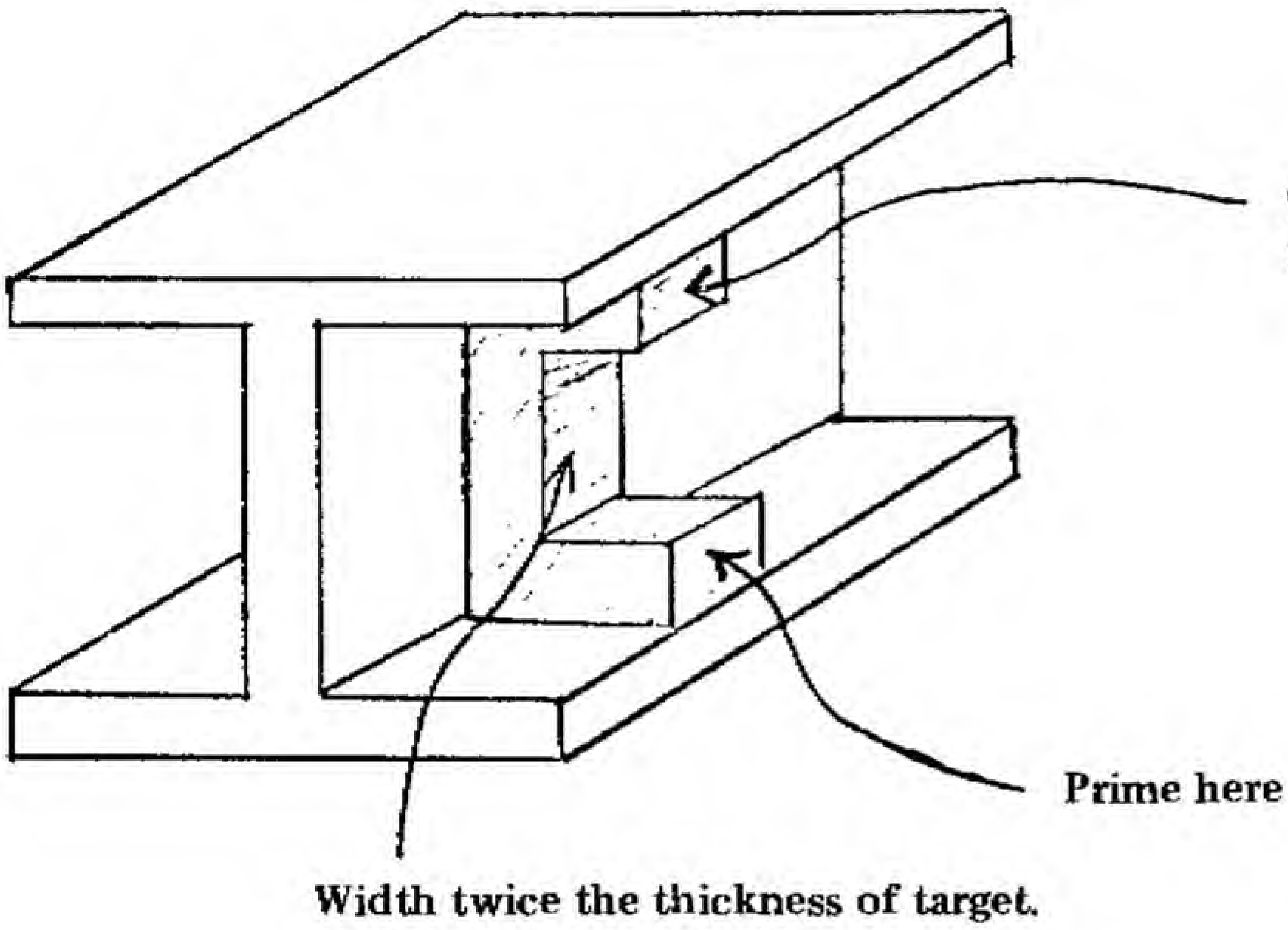


Figure 3. Ribbon Charge

6. PLATTER CHARGE: The platter charge is used to attack POL containers, transformers and switchboards, and other electrical equipment similar to switchboards. Construction (figure 4) requires a "platter," explosives, and a blasting cap. A container that the platter will fit into tightly is desirable as well as tape or string. The platter may be a dinner plate, seal-beam headlight, flat steel, ceramic plate, or other various materials. A round, concave, steel plate is best. The largest "platter" used thus far was a railroad fishplate. Plastic (C-3 or C-4) explosive is best; however, hard cast explosive, i.e., TNT may be melted and used to load the charge. A continer for the "platter" and explosive is desirable but not necessary as long as the explosive is held firmly against the "platter." An electric or non-electric blasting cap may be used to prime the charge at exact rear center.

The "platter" is placed in the container (if one is used) and the explosive is placed behind the platter. Weight of the explosive should be equal to the weight of the platter. The explosive must be uniform and solid. If the explosive is relatively thin, an area is built up in the center to accommodate the blasting cap.

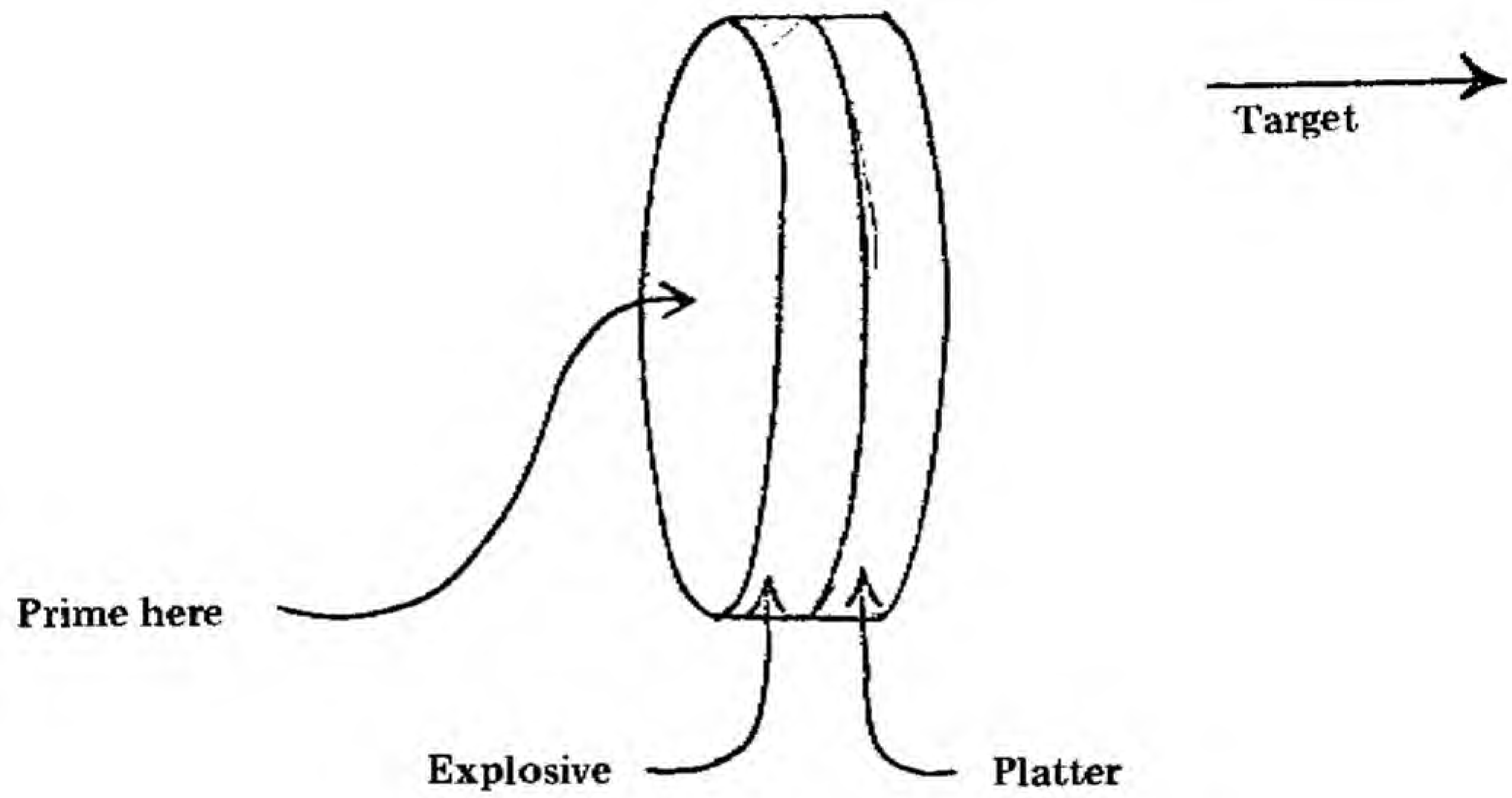


Figure 4. Platter Charge

7. SOAP DISH CHARGE: "Soap dish" is a nickname given to a charge designed to destroy POL and POL storage tanks. Any container about the size of a soap dish is used and one-half the volume of the container is filled with explosive (figure 5). The remaining portion of the container is filled with thermite. The thermite may be taken from a thermite hand grenade or be any one of the following mixes:

a. Three parts potassium chlorate and two parts sugar.
b. Two parts aluminum powder and three parts ferric oxide.
c. Any shavings from a metal turning lath.

The explosive is primed, electric or non-electric, and the charge is placed on target, ensuring that the thermite side is next to the target. A charge the size of a soap dish may be used to attack POL containers up to 100-gallon capacity. A charge the size of a cigar box may be used on containers up to 1,000-gallon capacity. A charge twice the size of a cigar box may be used on containers up to 5,000-gallon capacity, depending upon the tank configuration. Always ensure that the charge is placed BELOW the fuel level in the container.

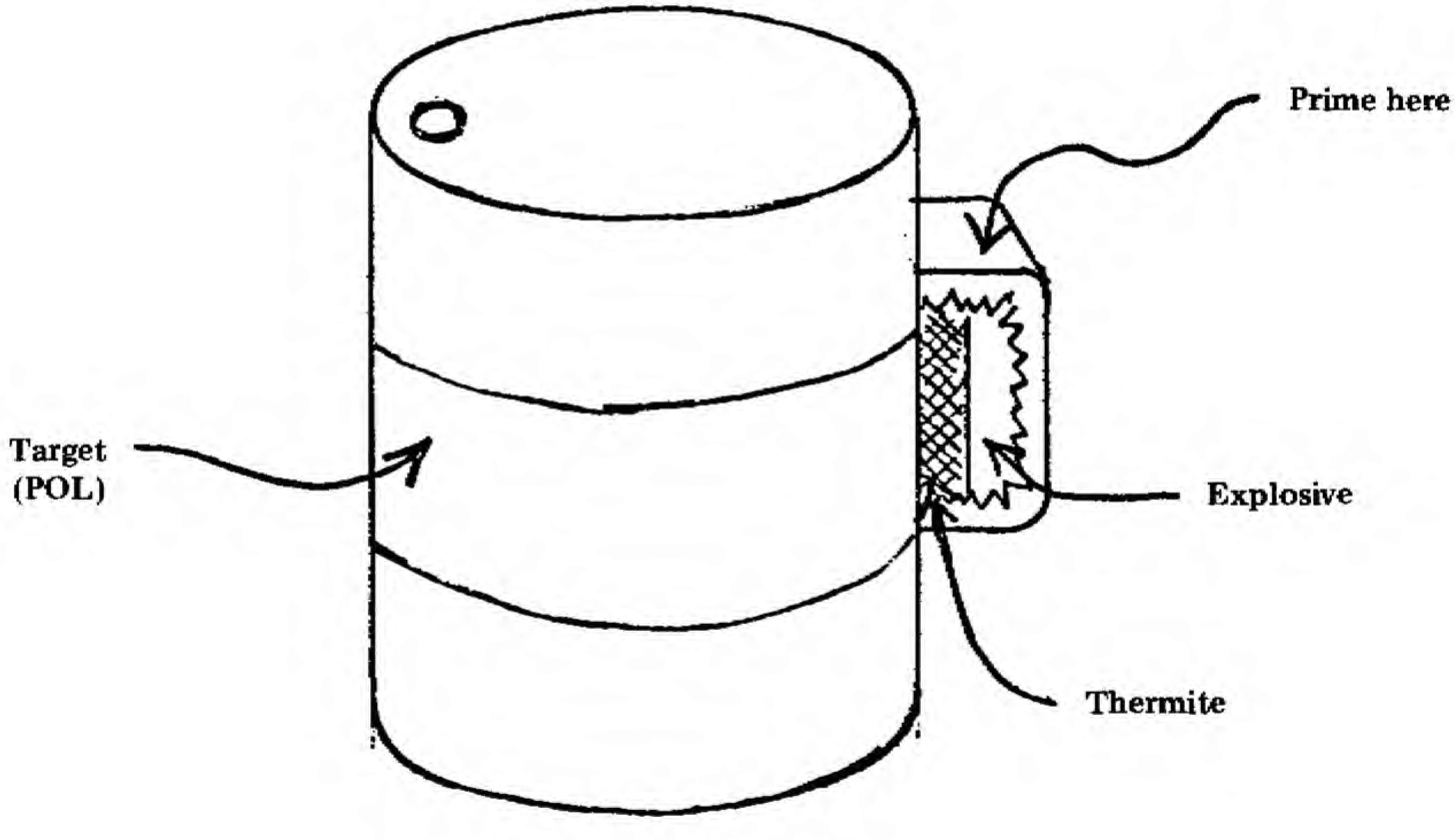


Figure 5. Soap Dish Charge

8. OPPOSED CHARGE: The opposed charge is used to attack concrete or masonry targets 4-feet or less in thickness. It is also referred to as the ear-muff and counterforce charge. The opposed charge has a limitation in the fact that at least two sides of the target must be exposed; however, a tremendous savings in explosive is achieved. The rule-of-thumb for construction is as follows: For each foot of target thickness, up to a maximum of 4-feet, use one pound of C-4. Round fractions of a foot off to the next higher foot. Divide the total amount of C-4 exactly in half, placing one-half of the charge on each side of the target (figure 6), diametrically opposite each other. Prime the two charges for simultaneous detonation. The target is destroyed as the shock waves meet in the center of the target and attempt to reflect each other. The reinforcement bars will not be cut by the shock waves but offer no support to the target by themselves.

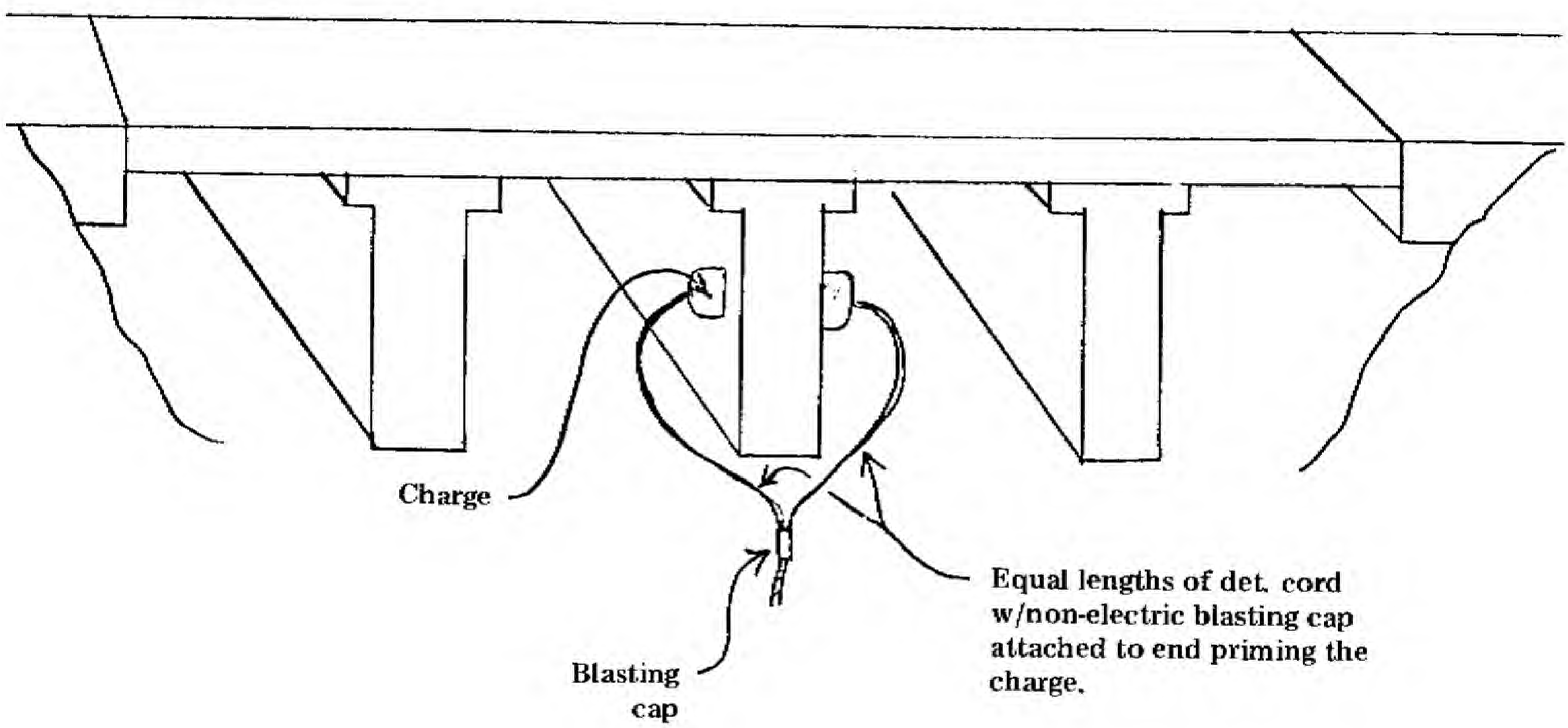


Figure 6. Opposed Charge

NOTE: Charges may be primed as shown above or by the two electric blasting caps wired in a common series circuit.

9. DUST INITIATOR: The dust initiator is an economical means of destroying targets such as box cars, warehouses, and any other relatively windowless structures. The dust initiator consists of two separate charges, the base charge and the cover or surround charge.

a. Base Charge: The base charge can be constructed by any of the following methods:

Crush one-half pound of TNT into a very fine powder. To this add the contents of a thermite hand grenade. In the absence of an issued thermite grenade use one-half pound of any of the following items: two parts of aluminum powder to three parts of ferric oxide; two parts magnesium powder to three parts of ferric oxide; three parts potassium chlorate to two parts aluminum powder. The base charge is then placed in any suitable container, i.e., paper bag, sock, wrapped in tin foil, etc. The base charge may be detonated by a non-electric or electric blasting cap. In the absence of TNT, Tetrytol, Comp B, or Penolite explosive may be substituted. They would be crushed the same as the TNT.

b. Cover Charge: The cover charge is a "surround" of any fine, dust-type material such as fine coal dust, cocoa, powdered coffee, confectioners sugar, tapioca, flour, cornstarch, hard rubber dust, aluminum powder, magnesium powder, and powdered soap.

c. The base charge is constructed and then placed inside of the cover charge. Use 3-to 5-pounds of cover charge per 1,000 cubic feet of building space. A 1-pound base charge will detonate up to 40-pounds of cover charge. The dust initiator is then placed in the building, warehouse, box car, etc., that is to be destroyed.

d. On detonation the base charge ignites the thermite mix and scatters the cover out into a cloud of dust. The burning thermite is projected through the dust, causing detonation.

e. Any volatile fuel may be used as a cover charge or "surround." However, never use more than 3-gallons of fuel for a 1-pound base charge. This size of charge will destroy buildings with up to 3,000 cubic feet of space. Use additional charges for any target over 3,000 cubic feet. When using several charges, detonate them simultaneously.

10. SQUARE CHARGE: The square charge is used to attack reinforced concrete targets 7-feet or less in thickness. Thickness of the charge will always be 2-inches or 4 inches and the charge must be approximately square. Refer to the Engineer Research and Development Laboratory chart (below) for thickness and number of blocks of C-4 or C-3 to be used in the charge.

Engineer Research and Development Laboratory Chart

Concrete Thickness	Charge Size	Charge Thickness
1 ft.	2 C-4 Blocks	One block - 2 in.
2 ft.	4 C-4 Blocks	One block - 2 in.
3 ft.	7 C-4 Blocks	One block - 2 in.
4 ft.	20 C-4 Blocks	One block - 2 in.
5 ft.	6 M-37 Kits (20 lb packet)	One M-37 Kit - 4 in.
6 ft.	8 M-37 Kits (20 lb packet)	One M-37 Kit - 4 in.
7 ft.	12 M-37 Kits (20 lb packet)	One M-37 Kit - 4 in.

NOTE: This charge may be primed direct rear center or at any one of the four corners. If employing a number of charges on a given target, you may use the formula $N = \frac{W}{2R}$

N = No. of charges
W = Width of target
2R = 2 x breaching radius

Improvised Paste Explosive.

The following information concerns the preparation and use of improvised paste explosive. It is a partial report of the early tentative results of a project conducted at the Engineer Research and Development Laboratory by Mr. Richard Kinsler, project engineer.

The "present paste explosive" alluded to in the first paragraph is a developmental item that might become standard at some time in the future for Army-wide use. The expedient preparation of past explosive using C-4 and commonly available materials is more valuable for our operations.

EXTRACT

Project 8F07-10-002-02

Summary of Past Explosive Work

Since the present paste explosive has several undesirable characteristics, such as: exudation of oil upon standing, lack of adhesive qualities, and the attacking of common plastics, there is a probability that the present paste will not be standardized for military use. In addition to the above mentioned detriments, there is also the probability that even if the paste were standardized, in its present form, it would not always be available to Special Forces units in the field. It is for these reasons that this preliminary investigation has been primarily concerned with finding a method of modifying C-4 to a paste consistency, not exude oil, not attack plastics, and have desirable qualitites of adhesion and cohesion.

Several different types of commonly available substances have been added to C-4 in an effort to produce an acceptable paste mix. The most promising of these mixes is listed in Apendix A. In general, it seems safe to say that C-4 will give a sticky, cohesive mix when mixed with most petroleum hydrocarbons. To the average soldier in the field this means that almost any product from the average POL dump is an acceptable agent to mix with C-4 to obtain a sticky paste mix. A very good agent is clear mineral oil such as may be found in any drug store. By the same token, C-4 will NOT give a good mix when using most water-soluble substances such as ethylene-glycol (permanent-type antifreeze), alcohol, surgical lubricant, glycerine, etc. The reason that water-soluble substances do not produce such good mixes is that the C-4 tends to exude the water-soluble agent, and the agent itself tends to give a smooth, creamy mix which has almost no adhesive qualities.

An attempt was made to produce an acceptable paste by mixing C-4 with some of the more common vegetable oils such as soy bean oil, corn oil, cottonseed oil, and peanut oil. When vegetable oils are used, the C-4 tends to lose its cohesive qualitites and gains absolutely no adhesive qualities. The resulting mix is a crumbly, non-cohesive mass which has a relatively low rate of detonation. Animal fats, such as butter, grease from cooked meat and lanolin were tried. The results were identical to the results obtained from the vegetable oils, with the exception of lanolin. Lanolin produces a mix which is not unlike the mix produced when petrolatum (vaseline) is used.

Preliminary tests to put these mixes to a practical use have begun. An extruder, which works by compressed air, has been designed and used to fill polyethylene tubes one inch in diameter with the paste. A tube, such as this, would be easily carried, by simply wrapping a length of the tube around a man's waist. When the target was reached, the necessary length of tube could be cut off, and attached to the target. The tube could easily be made into a ribbon charge simply by slitting it lengthwise and patting it flat after it is stuck to the target. See Appendix B for results of tests using this explosive filled tube against some of the more commonly encountered structural members.

It is to be remembered that the conclusions which are mentioned in this summary are valid in the light of present test results, but may be modified as more data are obtained.

APPENDIX A

Mix	Vehicle	By Weight	Density Range	Rateof Detonation	Remarks
1	SAE 10 Motor Oil	19	1.30 - 1.40	23,148	Appears to be a good mix. Is both adhesive and cohesive.
2	Paraffin Oil (Kerosene)	15	1.40 - 1.45	23,045	Adhesive and cohesive. Easily mixed.
5	Paraffin Oil (kerosene)	6	1.26 - 1.34	23,514	Good fibrous and sticky mix. Not as fluid as mix No. 2.
16	Varsol	10	1.40 - 1.54	23,390	Generally a good mix and tends to dry rather quickly, should be used within 24 hrs of the time it is mixed.
17	Fuel Oil	7.5	1.40 - 1.50	23,288	Good mix, very cohesive and adhesive.
19	Gasoline	10	1.70 - 1.80	Not determined	The gasoline evaporates rapidly, leaving the C-4 quite a bit drier than it was originally. Should be used only as a last resort.
20	Ethylene Clycol 20 (perm antifreeze)	20	1.34 - 1.60	Not determined.	Does not mix well with the C-4. The C-4 tends to repel the vehicle and therefore the mix exudes quite noticeably.
21	Diesel Oil	9	1.39 - 1.50	23,987	A good mix, on a par with fuel oil.

27	Lanolin	15	1.20 - 1.55	21,492	A good sticky, fibrous, cohesive mix.
34	Gilol (Mineral Oil)	14	1.32 - 1.40	22,577	A very good mix. Adhesive and cohesive to a great degree. Should stick to almost anything.
35	Petrolatum (Vaseline)	10.3	1.35 - 1.41	22,594	A very good mix also. Adhesive and cohesive enough to adhere to almost any surface which might be attacked.
57	Soy Bean Oil	4 Fl Oz Block C-4	1.49 - 1.51	23,474	Poor mix, marginally cohesive, no adhesion. Had to be primed w 2 caps before it would fire 2 misfires out of 3. A typical vegetable oil mix.

The above mentioned mixes can be duplicated with no measuring devices other than a ruler. The plastic sleeve which C-4 is shipped in is a standard size, thus can be used as a measuring device. A column of fluid 1½-inches up the sleeve contains one fluid ounce. For two fluid ounces, add 1¼-inches of column height to the original 1½-inches. The extra ¼-inch of column height in the first fluid ounce allows for the ¼-inch dead space at the end of every C-4 sleeve. Fractions of a fluid ounce may be determined by a simple proportion.

To duplicate the following mixes use the ratios described.

Mix	Vehicle	Inches of column height 2½ lbs. Block C-4
17	Fuel Oil	4 ⅜-inches
34	Gilol	7 ¾-inches

These two mixes are listed only as examples to illustrate how simple the mix measurements can be made.

APPENDIX B

In the following tests the tube of paste explosive was placed on a standard 16 WF 36 beam. The plastic tube which was used was one inch in diameter. In all shots on a WF beam, the explosive was laid across the flange, down the web, and across the opposite flange in the shape of a "C". On the other side of the web, a strip was placed on each flange.

Shot No. 1. 574 gms paste placed as described. Initiated with three electric caps. The beam was cut except in the upper fillets.

Shot No. 2. 419 gms paste placed as described. The strip along the web was ½ diameter of the explosive tube. Initiated with three electric caps. Beam severed except in fillets.

Shot No. 5. 1" x 3" steel bar used. 115 gms of paste laid across the width of the bar. Center primed. Complete cut.

Shot No. 16. 4" x 6" oak timber. 118 gms of paste used. Complete cut.

Shot No. 22. 90 lb yard. Railroad rail used. Two 1½-inch charges placed under the head of the rail. 80 gms total explosive used. Rail completely severed.

As a matter of interest, it should be noted that by the present steel-cutting formula of P ⅜A the following amounts are required and contrasted to the actual amounts used.

	P ⅜A	Actually Used

of $P = \frac{3}{8} A$ the following amounts are required and contrasted to the actual amounts used.

		$P = \frac{3}{8} A$	Actually Used
Shot 1	16 WF 36	1347.2 gms	574. gms
Shot 2	16 WF 36	1347.2 gms	419 gms
Shot 5	1x3 steel bar	382.8 gms	115 gms
Shot 22	90 lb/ yard rail	562.46 gms	80 gms

Materials That Can be Used to Improvise Explosive Incendiaries, and Some Delay Devices.

1. The following is a partial list of some chemicals and other material. The sources will differ from country to country but most of them can be found throughout the world. This will be an aid in securing chemicals. Also, a large quantity should be stored by the guerrillas prior to any large-scale use. The complexity of the problem confronting security forces attempting to control such items can readily be seen.

Coal dust
Common match heads
"Duco" model cement
Fuel oil
Kerosene
Rosin
Sawdust
Powdered coffee
Tapioca
Powdered rice
Hard rubber dust
Powdered soap
Turpentine
Fertilizer

Liquid floor wax
Photoflash powder
Paraffin
Petroleum
Pitch
Common sugar
Cocoa
Confectioners sugar
Flour
Cornstarch
Cork dust
Gasoline
Plaster of paris
Aluminum metal flakes

Ammonium nitrate
Ammonium perchlorate
Charcoal
Calcium carbide
Lead dioxide
Lead tetraethyl
Manganese dioxide
Aluminum (powdered)
Magnesium (shavings or powdered)
Zinc (powdered)
Sulfur
Sulfuric acid
Stearic acid
Nitric acid
Nitrocellulose (pyroxylin)
White phosphorous
Calcium hypochloride
Sodium peroxide
Carbon dissulfide
Barium peroxide
Naptha
Hydrogen peroxide (10 volume or higher)

Catechol
Dinitrobenzine
Glycerin
Limed rosin
Phenol
Potassium permanganate
Potassium nitrate
Potassium chlorate
Recorcinol

Red phosphorous
Sodium nitrate
Mercury salts
Nitrobenzine
Nitromethane
Sodium chlorate
Red lead
Potassium dichromate
Copper sulfate
Ferric oxide
Aluminum sulfate
Silver nitrate powder

2. Fast-Burning Primers: "Fast-burning primer" is a term applied to a flame-type ignitor used in conjunction with incendiaries. The primer mix is ignited and in turn ignites the incendiary. The fast-burning primer mix may be used as an incendiary. The following is a list of several of these mixes:

a. Chlorate-Sugar Mix. This mix consists of potassium or sodium chlorate and common sugar blended together. Proportions can be equal parts by volume or three parts chlorate to two parts sugar. The chlorate-sugar mix can be ignited by flame, spark, or acid. If unconfined the material will burn; if confined, detonation will result. A length of pipe filled with the mix, tightly capped and primed by any spark-producing item (i.e., time fuze, firing device) will produce a fine casualty charge.

b. Potassium Permanganate-Sugar. Another excellent primer is obtained by mixing nine parts potassium permanganate with one part sugar. This mixture may be ignited by a spark or by glycerine. It is used the same as the chlorate-sugar mixture.

c. Iodine Crystals and Aluminum Powder. This mix is obtained by blending equal volumes of iodine crystals and aluminum powder together. The product is slow in ignition but it burns much hotter than the chlorate-sugar or permanganate-sugar mixture. Ignition can be obtained by a spark or by introducing water. As the iodine burns a purple smoke is released. The smoke may be used for marking DZ's or signalling. However, the smoke is POISONOUS.

3. Flowerpot Incendiary. This incendiary device is referred to as a "flowerpot" incendiary, as a clay or ceramic container is required and the flowerpot is the most common such item found around the world. Tape the hole in the bottom of the flowerpot. Run a cardboard tube from the hole to the top of the pot. Fill the pot (not the tube) to within 1-inch of the top with a mixture of three parts iron oxide and two parts aluminum powder. The tube and remainder of the pot are filled with any of the first fire mixes. The means of ignition is attached. This item can be used to attack machinery, generators, transformers, and any inflammable materials.

4. Molded Incendiary:

a. The formula for the molded incendiary is three parts aluminum powder, five parts plaster of paris and four parts water mixed by volume.

b. Place the three parts aluminum powder and five parts plaster in a suitable container and blend together.

c. Add four parts water and stir together well. After mixing, place in a mold.

d. Remove the mold after about 30 minutes has elapsed. The incendiary must be air-dried for a period of 2 weeks or baked in an oven for a period of 6 to 8 hours at 350 degrees F. before it is employed.

e. Ignition is best obtained by producing a priming well, filling the well with magnesium shavings, and igniting the shavings with a fast-burning primer.

5. Pipe Bomb:

a. A hand grenade can easily be improvised by confining any of the fast-burning primers in a strong container, i.e., length of pipe, ceramic container, etc., and providing a means of ignition.

b. When the primer ignites and begins to burn, the expanding gas will rupture the container producing a small explosion.

6. Sawdust and Tar or Wax:

a. An excellent incendiary may be improvised by adding molten wax or tar to sawdust.

b. The wax or tar is mixed with the sawdust at a ratio of about 50-50.

c. Any fast-burning primer will ignite the mixes quite readily.

7. Improvised Napalm:

a. Napalm may be improvised from gasoline and soap.

b. First, cut the soap into fine chips; next, boil the gasoline.

c. The gas may best be boiled by placing about one gallon of fuel in an open container. The gas is ignited and as it burns it will generate enough heat to cause itself to boil.

d. After the gas is boiling rapidly, slowly stir in the soap chips until a jelly-like substance is obtained.

e. This material is readily ignited with a match, WP grenade, or the "soap dish" charge.

TABLE I

VEGETABLE OILS	NORMAL USE	COMMON SOURCE
Boiled Linseed	Paint Manufacture	Hardware Store
Raw Linseed Oil	Paint Manufacture	Hardware Store
Safflower Oil	Food	Drugstore / Food Store
Tung Oil (China Wood)	Paint Manufacture	Paint Manufacturer
DRIERS	**NORMAL USE**	**COMMON SOURCE**
Cobalt (6%)	Paint Manufacture	Paint Manufacturer
Lead (24%)	Paint Manufacture	Paint Manufacturer
Manganese (Can Be Substituted for Cobalt 6%) *		
Lead Oxide (Can be Substituted for Lead 24%) **		
COMBUSTIBLE MATERIALS	**NORMAL USE**	**COMMON SOURCE**
Cotton Waste	Machine Shops Maintenance Shops	By-product of Textile Manufacture
Cotton Batting	Furniture Manufacture	Felt & Textile Manufacturer
Sawdust	Water-Oil-Grease Absorbent	By-product of Wood Working
Kapok	Life Jackets, Furniture Padding & Bedding	Furniture Manufacturer Wood Products Manufacturer

* See Instructions for preparation, page 0501.11

** See Instructions for preparation, page 0501.12

TABLE I (Continued)

MISCELLANEOUS ITEMS	NORMAL USE	COMMON SOURCE
Cardboard or Paper Confinement Container	General	Commonly Available
Stick approximately 1½ inches in diameter	General	Commonly Available
Sharp Knife	General	Commonly Available
One pint wide mouth jar	General	Commonly Available
Teaspoon	General	Commonly Available
Fire Fudge Igniter (0202) (optional)	To ignite incendiary material	See page 020.1, Unconventional Warfare Devices
Fuze Cord (0101) (optional	Primary Initiator for Igniters & Explosives	See page 0101.1, Unconventional Warfare Devices & Techniques Manual

TABLE II

SYSTEM NUMBER	VEGETABLE OIL	COBALT DRIER	LEAD DRIER	COMBUSTIBLE MATERIAL
1	Boiled Linseed Oil, 1/3 pint	1/2 teaspoon	2 teaspoons	Cotton Waste, 1 pint tightly packed
2	Boiled Linseed Oil, 1/3 pint	1/2 teaspoon	2 teaspoons	Cotton Batting, 3 pints tightly packed
3	Boiled Linseed Oil, 1/3 pint	1/2 teaspoon	2 teaspoons	Sawdust, 1 pint tightly packed
4	Boiled Linseed Oil, 1/3 pint	1/2 teaspoon	2 teaspoons	Kapok, 1 pint tightly packed
5	Raw Linseed Oil, 1/3 pint	1 teaspoon	4 teaspoons	Kapok, 1 pint tightly packed
6	Safflower Oil, 1/3 pint	1/2 teaspoon	2 teaspoons	Cotton Waste, 1 pint tightly packed
7	Safflower Oil, 1/3 pint	1/2 teaspoon	2 teaspoons	Cotton Batting, 3 pints tightly packed
8	Safflower Oil, 1/3 pint	1/2 teaspoon	2 teaspoons	Sawdust, 1 pint tightly packed
9	Safflower Oil 1/3 pint	1/2 teaspoon	2 teaspoons	Kapok, 1 pint tightly packed
10	Tung Oil, 1/3 pint	1/2 teaspoon	2 teaspoons	Cotton Waste, 1 pint tightly packed

TABLE II (Continued)

SYSTEM NUMBER	VEGETABLE OIL	COBALT DRIER	LEAD DRIER	COMBUSTIBLE MATERIAL
11	Tung Oil, 1/3 pint	1/2 teaspoon	2 teaspoons	Cotton Batting, 3 pints tightly packed
12	Tung Oil, 1/3 pint	1/2 teaspoon	2 teaspoons	Sawdust, 1 pint tightly packed
13	Tung Oil, 1/3 pint	1/2 teaspoon	2 teaspoons	Kapok, 1 pint tightly packed

NOTE: The above quantities for each system are approximately correct for use in a 1 gallon confinement container. The impregnated combustible material should fill the container to approximately 1/3 to 1/2 the volume for best results. Different size confinement containers can be used with properly adjusted quantities of impregnated combustible material. At approximately 70 degrees F delay time to ignition is roughly 1 to 2 hours. With Fire Fudge or Fuze Cord added to the impregnated combustible material, delay time is reduced to roughly 1/2 to 1 hour. The exception to this is system 8 where delay time to ignition is about 2 to 3 hours. With Fire Fudge or Fuze Cord added, delay time is shortened to 1 to 2 hours.

C. PREPARATION:
GENERAL INSTRUCTIONS FOR PREPARATION OF A RELIABLE SPONTANEOUS COMBUSTION DEVICE.

1. Measure the combustible material by tightly packing it up to the top of the one pint measuring jar. The material should puff out of the measuring jar when firm hand pressure is removed.

2. Transfer the combustible material from the measuring jar to the confinement container.

3. Pour the vegetable oil into the one pint measuring jar to one-third jar volume.

4. Using a teaspoon, add the specified quantity of Cobalt Drier to the vegetable oil in the one pint measuring jar. Wipe the spoon dry and add the specified quantity of Lead Drier to the Vegetable Oil-Cobalt Drier mixture.

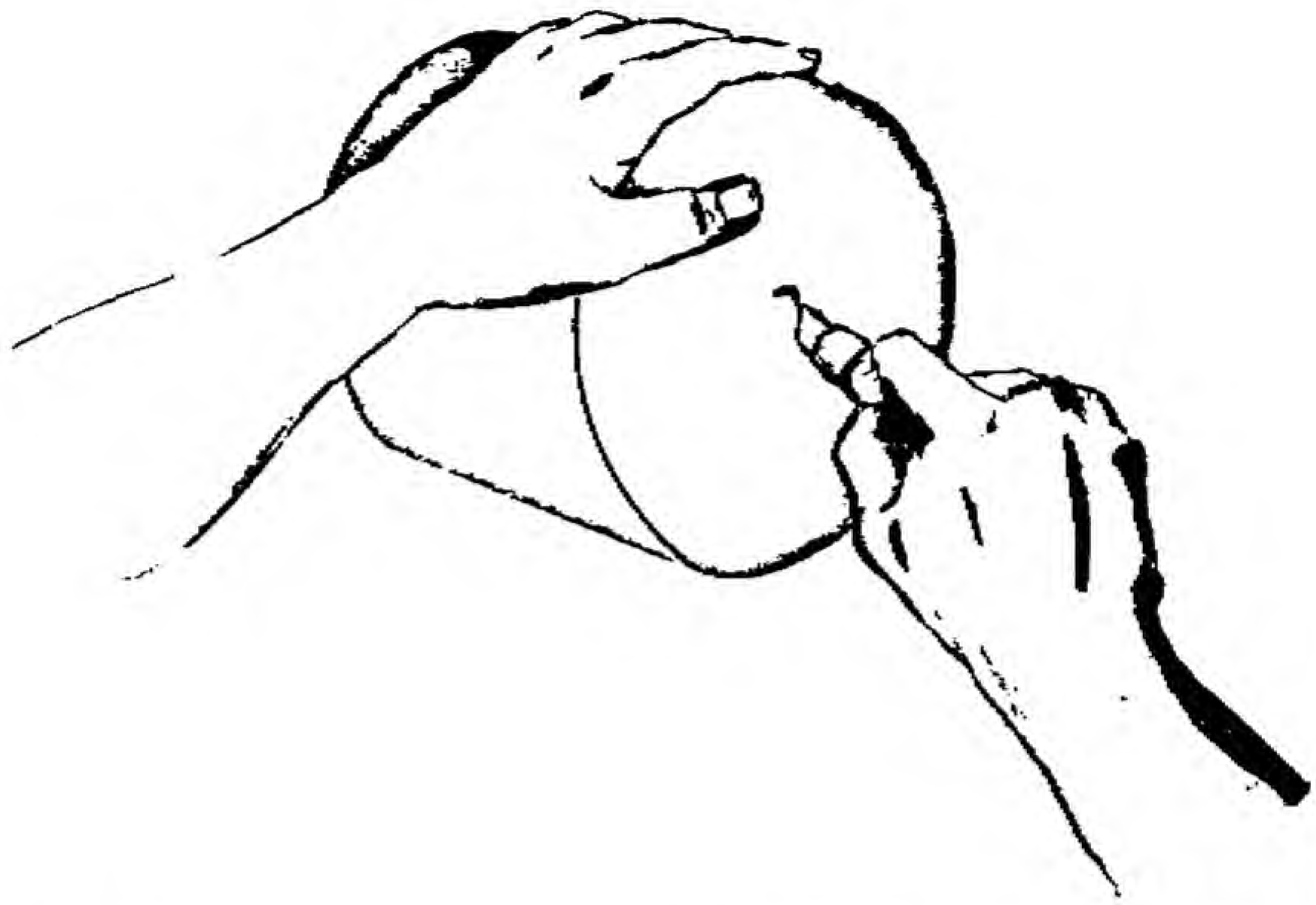
5. Thoroughly mix the combination of vegetable oil and driers by stirring with the teaspoon for approximately one minute.

NOTE: Vegetable oil and drier can be mixed and stored in an air-tight container for one week before use. Longer storage is not recommended.

6. Pour oil mixture from the one pint measuring jar over the combustible material in the confinement container. Saturate the combustible material by kneading, pulling and balling with the hands. This can be accomplished either in or outside of the confinement container.

7. Remove saturated combustible material from the confinement container.

8. Cut a hole one to two inches in diameter in the center-bottom of the confinement container with a knife.



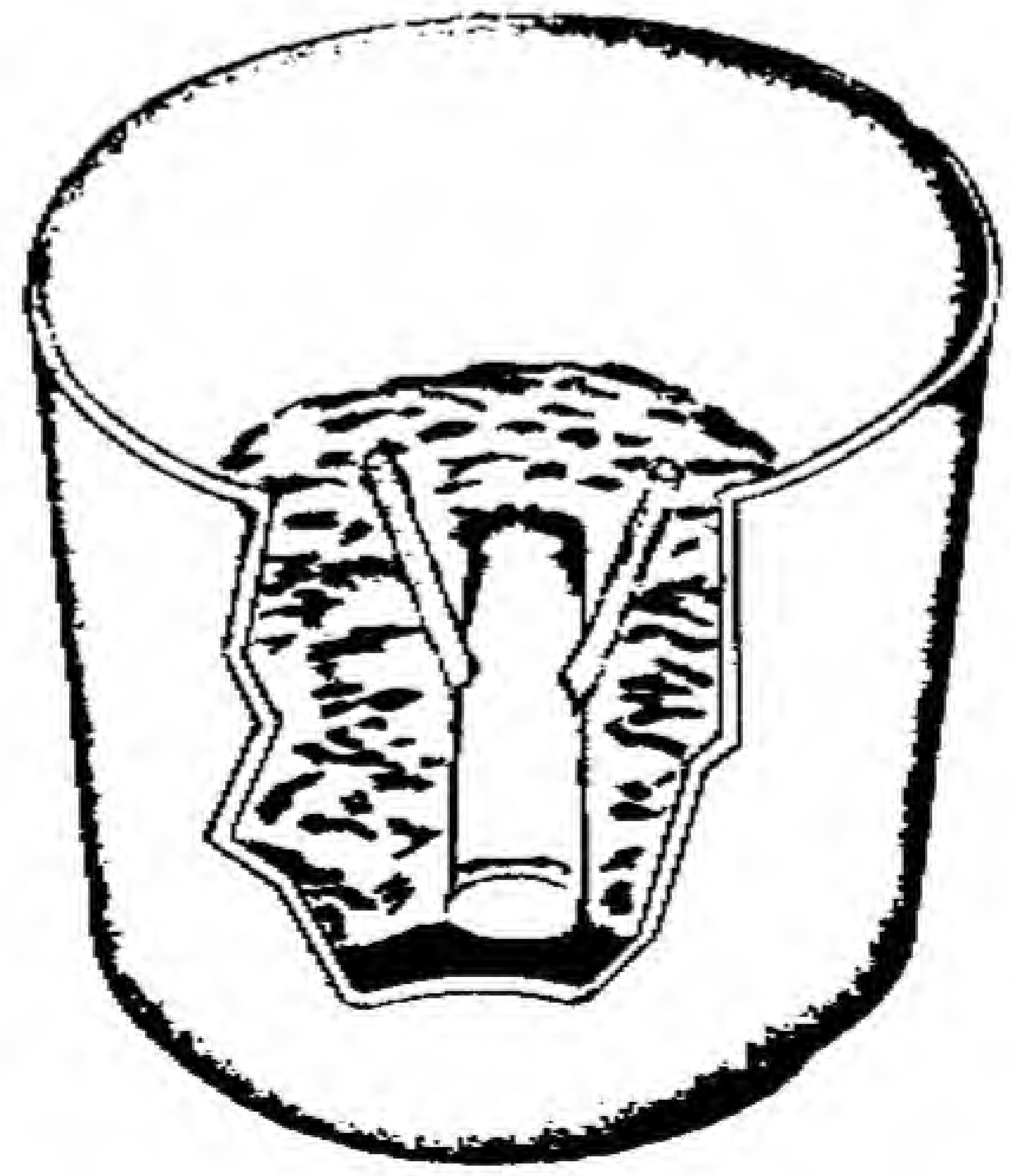
9. Place confinement container on a flat surface, hold the 1½-inch diameter stick vertically over the hole in the bottom of the confinement container and pack the saturated combustible material around the stick compressing it so that it fills 1/3 to 1/2 of the confinement container volume after hand pressure is removed.

10. Remove the stick. This leaves a ventilation hole up through the center of the combustible material. The spontaneous combustion device is now ready for application unless the following optional step is used:

11. This step is optional. Take a piece of Fire Fudge (0202) about the size of a walnut and crush it into pieces about the size of peas. Sprinkle the pieces of crushed Fire Fudge on top of the combustible material.

OR

Cut a piece of Fuze Cord (0101) to a length of about four inches. Since safety fuze burns inside the wrapping, it is sliced in half to expose the black powder. (Lacquer coated fuze (non-safety type) burns completely and may be used without slicing.) Insert one or more pieces of fuze vertically in the combustible material near the center vent hole leaving about one inch extending out of the top surface of the combustible material.



D. INSTRUCTIONS FOR PREPARATION OF IMPROVISED DRIERS:

1. If the commercial driers (Cobalt-6 % and Lead-24 %) specified under Material and Equipment are not available, the following improvised driers can be made starting with flashlight batteries and powdered lead oxide (Ph_3O_4). These improvised driers are used in the same manner as the commercial driers.

a. MANGANESE DRIER:

(1). Break open three flashlight batteries (size D) and collect the pasty material surrounding the central carbon rod.

(2). Put this material in a one pint wide mouth jar and fill jar with water.

(3). Slowly stir contents of jar for approximately two minutes and allow contents to settle. The contents will usually settle in one-half hour.

(4). Pour off water standing on top of settled contents.

(5). Remove wet contents from jar, spread it on a paper towel and allow to dry.

(6). Dry the jar.

(7). Pour raw linseed oil into the one pint measuring jar to one-third jar volume.

(8). Combine the measured quantity of raw linseed oil and the dried battery contents from step 5 in a pot and boil for one-half hour.

(9). Shut off heat, remove pot from the heat source and allow the mixture to cool to room temperature.

(10). Separate the liquid from the solid material settled on the bottom by carefully pouring the liquid into a storage bottle--discard the solid material. The liquid is the drier.

(11). The manganese drier is ready for use.

(12). If manganese dioxide powder is available, flashlight batteries need not be used. Place one heaping teaspoonful of manganese dioxide powder into the raw linseed oil and boil the mixture in a pot for one-half hour. Then follow steps 9, 10 and 11.

b. LEAD OXIDE DRIER:

(1). Pour raw linseed oil into the one pint measuring jar to one-third jar volume.

(2). Combine the measured quantity of raw linseed oil and two heaping teaspoonfuls of lead oxide in a pot and boil gently for one-half hour. The mixture must be stirred constantly to avoid foaming over.

(3). Shut off heat, remove pot from the heat source and allow the mixture to cool to room temperature.

(4). Pour the liquid into a storage bottle and cap the bottle.

(5). The lead oxide drier is ready for use.

E. APPLICATION:

1. The spontaneous combustion device is placed at the target on a flat surface with one edge propped up to allow ventilation through the impregnated combustible material.

Since flames normally shoot up from the open top of the confinement container, combustible target material should be positioned from three to five inches directly over the top of the device for satisfactory ignition of the target. DO NOT COVER OPEN TOP OF DEVICE.

2. Temperature of the environment in which these devices are used affect the ignition time. In order to estimate the delay time, the user is referred to the following table which gives approximate time to ignition at different temperatures. It is recommended that ignition time be determined by advance trial.

Temperature (°F)	Time to Ignition (Hours)
60-70	1-2
40-60	2-4
30-40	4-10

3. Spontaneous combustion devices can also be improvised by stuffing impregnated combustible material into a pocket of any one of the following garments: coat, laboratory jacket, pants or other similar item.

The quantity of combustible material stuffed in the pocket should all be below the top of the pocket and it should not be packed too tight.